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A BATAK AND MALAY CHANT ON RICE CULTIVATION, WITH INTRODUCTORY NOTES ON BILINGUALISM AND ACCULTURATION IN INDONESIA

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(*Read April 25, 1952*)

INTRODUCTION

DURING two periods of residence in Asahan, Sumatra, in 1918 and 1927, the writer collected a large number of manuscripts of ethnological interest. These were mostly from a dwindling remnant of lowland Batak who occupied what remained of the former tiny pagan "kingdom" of Silo Maradja. These people were a part of a linguistic and ethnic group who called themselves Halak Pardembanan, "people of betel-quid place," a name which had an extended meaning, as they explained it, and signified that they were those who made friendship pacts by the betel-chewing ceremony. Their name for the betel-pepper vine is *demban*. Pardembanan as a geographic name, therefore, means not only "place where betel grows," but also "place where betel chewers live."

At Silo Maradja I was ceremoniously adopted as the younger brother of the hereditary chief, Radja Ria Maradja *marga* Sirait Holboeng, whose official status with the Dutch colonial government was that of a relatively insignificant village headman (*kapala kampong*). Most of the people were still pagan (*parbegoe*) but some had become Muhamadan, or, as they put it, "had entered Islam" (*soedah masoek Islam*). Some of the neighboring communities had no declared pagans left, but others, like Silo Maradja, were mixed, or, at some distance inland, trending toward Christianity instead of Islam.

THE TWO LOCAL DIALECTS

At Silo Maradja the population was a typically bilingual one. The pagans (*parbegoe*) preferred to speak the local dialect of Batak, called *bahasa Pardembanan* (Pardembanan speech), whereas those who, as nominal Muhamadans, were more consciously identifying themselves with the Malays, preferred to speak the local Malay, which differed considerably from standard Malay of the official school books and of then current Malay-Dutch dictionaries, such as that of Badings (4),[1] which was the one chiefly used in the preparation of the linguistic notes accompanying this article and to which I have adhered for the spelling of standard Malay. My spelling of both Malay and Batak words follows the Dutch usage of the time when the manuscripts were collected and my own notes and vocabularies were made. The more sophisticated Muhamadans conformed to a varying extent with standard Malay, but in both speech and writing mixed it with dialectical Malay and Batak and thus fell more or less into what they called "village talk."

Just as the "village" dialect of Malay varied from the standard or "school-book" language, and was likewise far from uniform,[2] so the local Batak of Asahan was also far from uniform. The customary and often mixed speech of the prevailingly Batak-Malay or Malay-Batak bilinguals was politely not called "Batak" but preferably *bahasa kempoeng* (village speech) "so as not to shame Muhamadans of Batak origin." Men who had mingled with the Toba highlanders attempted to conform with Toba rather than the lowland speech, because Toba speakers found the dialect of the Pardembanan lowlanders ludicrous. So "Batak" as spoken in Asahan varied greatly, especially in the break-down of Toba grammar and in the amount of substitution of Malay for Batak words. Likewise, some of the deviation from Toba came about

[1] Numbers in parentheses indicate references at end of article.

[2] As the writer looks over his language materials, obtained from many informants, it is clear that there is considerable variation from one writer to another, both in Malay and in Batak. It may well be that the next manuscript to be edited will have minor variations of spelling which will truly indicate differences of pronunciation between different speakers. It will be the policy of the writer to make no changes of spelling in order to bring about agreement, even within the same manuscript. The transcription represents exactly what the manuscript has, except for the occasional insertion of an omitted syllable, indicated by brackets. Of course some variant spellings are mere errors.

by intergradation with the Tanah Djawa dialect of Simĕloengoen (called Sibaloengoen or Simaloengoen by the people of Asahan) adjoining the Pardembanan on the Northwest. The chief (*radja*), the priest (*datoe*), and the medium (*sibaso*) had to be better versed in true Toba than others, because they must supposedly be able to communicate in spiritualistic ceremonies with remote highland *marga* (sept) ancestors who would speak only pure Toba!

Nevertheless, in spite of intergradation, there were two dialects spoken in the old established population of the low part of Asahan. Malay was the mark of assimilation to the higher Muhamadan culture: Batak indicated retention of an older pagan culture and conservatism in general. The sub-Toba dialect of Asahan, although variable, may fairly enough be distinguished as Pardembanan Batak, or Pardembanan speech, as its speakers call it. To call it merely Toba would arouse derision of any speaker of the latter language. Many persons were truly bilingual and used whichever dialect seemed most appropriate. Women, more conservative than men, were more likely to use the Pardembanan dialect by preference, and to teach it to the children before the latter began picking up Malay by outside contacts.

It would hardly be possible to define the Pardembanan dialect linguistically or geographically. Some said that its chief characteristic differences from Toba were mostly derived from the next linguistic area northward, across the Soengei Silo (Silau) namely, Sibaloengoen or Simaloengoen (officially, and actually, in much of the area where spoken, Simĕloengoen), where there was likewise a bilingual population between Simĕloengoen proper and the Malay of Batoe Bara. Simĕloengoen dialect blended, toward its northwest boundary, with Karo, and the latter into Malay in its own part of the coastal plain. This is in accordance with the usual pattern of linguistic geography in Indonesia.

Little seems to have been published concerning the dialects called Simĕloengoen Batak (also known as Timoer Batak) although there are a few texts available. A manuscript vocabulary was compiled by Voorhoeve, to which I contributed a short word list (made in Silo Maradja) of the Simĕloengoen dialect used across the Soengei Silau Toewa in the adjoining district of Tano Djawa. His work was destroyed before publication, during the war.[3]

[3] Joustra (17, p. 301), commenting on the almost complete lack of knowledge of Simĕloengoen language and literature in 1926, said that Malay was understood by a large part of the population of the lowlands, and, as much as necessary, spoken. This was so largely true that a non-observant visitor might conclude that Malay was the indigenous language of the region bordering Batoe Bara and the plantation belt.

The local Malay dialect prevailed among the country people near the mouth of the Asahan river around Tandjoeng Balei. At Hessa, only a few kilometers away, the Batak dialect had almost fallen into disuse and only one man could (or would) write in Batak script. According to Anderson (1) Hessa, the Soengei Kesa of his account, was already, in 1823, "principally occupied by Malays." It must be borne in mind that then, as now, a "Malay" was one who spoke Malay as his chief language and was a Muhamadan. "Malay" is a term defined largely by religion and language rather than race. At Bandar Pasir Mandogei and Boentoe Panei, as at Silo Maradja, they were using either dialect in 1918, the Muhamadans and the men in general speaking Malay freely, the unregenerate pagans and the women preferring Batak, and all using borrowed words freely.

Down to 1927 very few of the genuine country people had been influenced by the standard Malay of the schools. The schools served only the few larger centers of population and the dense plantation populations, which were mostly Javanese. Contact of the local people with plantation workers was avoided, when my manuscripts were collected, but conditions doubtless changed very greatly in later years, especially by the war-time dispersal of many thousands of immigrant Javanese and other plantation laborers through the older and sparse basic population. Likewise, there has been time, since 1927, for schooling to have become a much more important factor in standardizing speech.

Following the introduction of "the great cultures" (agricultural!) into Asahan the process of assimilation to a generalized modern Malayan culture encountered complications, for the new economy brought in thousands of Javanese, Soendanese, Bandjarese, Chinese, and Tamils, who provided as effective a melting-pot in the making of "Malays" as the great deficiency of women and prevalence of disease permitted.

LITERACY OF THE PARDEMBANAN BATAK

The people of Silo Maradja have been at least semi-literate for hundreds of years. For generations they had generally written with a knife-point

on bamboo in the Batak character, but many years ago they had become accustomed to using pencil or pen and ink on paper when they could get materials. They preserved, in fact, various old manuscripts on paper rolls, with or without a rod through the center. These were mostly concerned with legendary history and genealogy (*tarombo*). Some bamboo manuscripts were also old, but bamboo was likely to be used for ephemeral writings. The inner bark of the *alim* tree folded accordion-wise, was the material upon which their most ancient books of magic (*poestaha*) had been written, and briefer magical writings such as incantations were inscribed upon shoulder-blades or ribs. Their script differed slightly from that of Simëloengoen or of Toba, and considerably from that of Karo.

The art of writing the Batak script was informally taught by anyone who knew it (generally the *datoe*, priest-magician) to anyone who wished to learn. One who had a disciple was a *goeroe* (teacher). If several boys learned at once, there was an amusing graduation ceremony. The *goeroe* or *datoe* dictated a prayer with an appropriate magical formula to be scratched on bamboo over a heap of boiled rice. If inspection showed that the writing was correct, the *datoe* recited an appropriate invocation and instructed the boys to eat the rice and with it "the soul of the writing" (*tondi ni soerat*), which was represented by the scratchings from the cuticle of the bamboo, which, of course, corresponded exactly to the characters of the inscription.

Those who could read and write in Batak characters were keenly interested in correct pronunciation, for spelling was strictly phonetic. Matters of spelling were frequently the subject of critical comment, especially when I was learning to write and submitted for inspection words that had been dictated to me. Anyone who could write needed only a little encouragement to act as *goeroe*.

By way of contrast with Batak script, which was commonly used for Malay as well as Batak, Arabic script could be written or read only by the most thoroughly Malayanized men. Lithographed Malay books in the Arabic alphabet were sold in considerable numbers at Tandjoeng Balei, the capital of Asahan, but seldom reached such a rustic place as Silo Maradja, although anyone who acquired reputation as a *lobih* or Muhamadan teacher had to be able to write, painfully, a few words in Arabic script.

BATAK COLONIZATION IN LOWER ASAHAN

Within historic times the highland Batak have more or less continually overflowed into the lowlands of the low coastal plain along the Straits of Malacca, at first by the swarming off of small pioneering colonies that made up definite social units, later by addition of miscellaneous new-comers to the older-established units. The septs first making up the colony seem generally to have maintained a social ascendancy, in that the chieftainship was not ordinarily allowed to pass to the *marga* of a late-comer.

Recorded and credible tradition indicates that the Asahan River was colonized all the way to the mouth by Batak from the upland of Habinsaran and Toba, for the lines of descent of recognized Muhamadan sultans and "pretenders" traced back to the same founding ancestors, who belonged to *marga* (marriage septs) that prevailed in the still non-Islamic part of the population.

The Batak people, wherever they colonized, kept manuscript memoranda (*tarombo*) of their traditional origin and of the ancestry of their chiefs. The writer has in his collection a number of them (still unedited) which originated in various districts. European writers have referred to the legendary account of the early history of the Batak colony at Tandjoeng Balei, the chief town at the mouth of the Asahan River. It was given by Kroesen (22) and repeated by Hamerster (15). There is a text from Toba sources in the admirable book of the Batak folk-historian Hoetagaloeng (16, p. 95) which gives the legend regarding the colonization of Koewaloe and Asahan, and the same material is repeated in a work by Ypes (35) which is among the best in the entire field of Indonesian ethnography. As given by Hoetagaloeng the legend of relationship of the Malay sultans to the Batak chiefs runs as follows: A certain Batak chief, Naga Isori by name, with a companion, Pakpak Hoenal, formed a settlement near where Tandjoeng Balei is now located, near the mouth of the Asahan River, where the latter is joined by the Silo (Silau) River. One of his sons was the ancestor of the "radjas" (sultans) of Koealoe, the other of the "radjas" of Asahan. (The sultans of early days were still called *"radja"* by the pagans.) Naga Isori is said to have visited Perak and to have married there as his second wife a daughter of the *"radja"* of Perak, whose son became the *"radja"* of Siak!

The line of sultans that was recognized by the Dutch as ruling Asahan traces its ancestry to a Batak chief, Radja Si Margolang, and his com-

panion Bajak Lengga, referred to by Kroesen (22) and Hamerster (15) as a Karo Batak, but more likely of the Toba *marga* Haro, which, according to the Batak traditions, went to Karoland from Toba, and may have been originally a Toba *marga*.

From Batak *tarombo* we learn the traditional derivation of certain *marga* (exogamous marriage septs) some of which were at least recently dominant in the region under consideration. The *marga* of the chiefs of Silo Maradja is Si Rait Holboeng, the subsept designation Holboeng indicating the line that migrated to the lowland, whereas the line Si Rait Dolok remained in the mountains, and does not really need the subsept designation to define it. The *tarombo* differ in details, but a genealogy published by Ypes (35) records a Radja Mardopang who had a son Si Toroes to whom the *marga* of the same name is traditionally traced. The latter had three sons, one of whom was the progenitor of the *marga* Pane, which colonized in the former little Simĕloengoen state of Panei (3). In Asahan it still rates as a subsept with the name *marga* Si Toroes Pane. One of the other sons was the ancestor of the subsept Si Toroes Boltok. *Marga* Si Toroes at Silo Maradja is the *"hoela-hoela" marga* to Si Rait Holboeng, that is to say, the preferred sept from which wives are chosen, and one may therefore assume that *marga* Si Rait and *marga* Si Toroes were associated in colonizing Silo Maradja. The other most important sept is *marga* Si Naga. The area in which these three *marga* prevail is the Pardembanan region, but they also occur as secondary *marga* among the Simĕloengoen Batak. Another important sept, Si Boeeja (Si Boeea), will be mentioned in the following section.

NON-BATAK BUT PRE-ISLAMIC INFLUENCES IN ASAHAN AND TANAH DJAWA

In Asahan and adjoining Simĕloengoen there is a legend of "foreign" (*"djaoe"*) colonization at a time antedating definite historical knowledge of the region, which, together with the name "Tanah Djawa" for the closest Simĕloengoen unit, has led to the conclusion of several writers, namely Kroesen (21), Hamerster (15), and others (2), that the colony was Hindu-Javanese. The particular ethnographic features that indicate such pre-Islamic colonization or strong cultural influence include the use of the peculiar grave-post known as the *anisan* (6) and the existence of sacred structures which, with an associated sacred inclosure, served the function of a temple (8). The name of the grave-post is derived from Arabic, but there is no reason to believe that all ancient Arabic language contacts with Indonesia were necessarily Islamic, in view of India intervening between Arabia and Sumatra, affording plenty of room for the long persistence of non-Islamic Arabs. The symbolism of the grave-post is more Indic than Arabic. There are many vestiges of Hinduism in all parts of the Batak lands (the Hindu name of the *marga* Si Naga, the serpent sept, being one of them) but in the South, the region of Padang Lawas especially, many ruins of Hindu structures have been discovered. So the pre-Islamic racial, religious, and linguistic contacts of the Batak cannot be ignored even if the actual historical record throws no light upon them. The Batak called all foreigners, including Malays, *djaoe*, and the *djaoe* of myth may as well have been Hinduized Malays as Hindus or Hinduized Javanese.

Whoever they were, the *djaoe* may well have infused enough of their blood and culture into the early lowland Batak population so that they were largely responsible for the distinctions that exist between the people of Toba and those of the Pardĕmbanan area. There may also have been, however, a local aboriginal group to modify the highland Toba Batak type prior to or concurrently with the colonization of the lowland by the *"djaoe."*

In Asahan there were, according to some informants (inconsistent with fact, so far as at least one additional *marga* was concerned), only three main *marga*, existing in several subdivisions, to which a Pardĕmbanan chief could belong. These were Si Toroes, Si Rait, and Si Naga. We may think of the first two as Indonesian, the third as possibly Hindu, as indicated by the name *Naga*. Another important sept was Si Boeeja, which appears to represent an ancient and probably weak lowland population which was accepted as part of the social structure by invading highlanders. It seems (Bartlett (9)) to have been of Negrito affinity. If this supposition is true, the Negrito-like lowlanders may have been ruled by a Batak chief at the time of their incorporation into the Batak *marga* system, for Hoetagaloeng (13) gives the following rather vague tradition [4] of the origin of *marga* Si Boeea, the crocodile sept:

[4] "Ia pinompar ni Simangara, gabe marga 'Siboeea' do. Songon on do baritana: Adong do nadjolo sada ambar margoar 'Ambarbortoeng' djonok toe Onan Lagoeboti, djala djonok toesi do hoeta ni Simangara. Adong do di ambarna i boeea, gabe digoar halak ma ibana 'parboeea' laos 'Siboeea' ma marga ni pinomparna."

The offspring of Si Mangara became the crocodile sept. The story about it is that there was a little pond called giant-frog pond near the market place of Lagoe Boti and round about it Si Mangara's village. In his pond there was a crocodile, for which reason the people there were named for the crocodile and so the *marga* of his descendants was that of the crocodile.

Since the older generations of the *tarombo* represent myth rather than fact, not too much reliance should be placed upon the highlanders' explanation of this tradition, which has certain peculiarities requiring explanation, as follows. The *marga* Si Boeea did not take its name from its founder, but from people of his village who were identified with the crocodile. This could not have been at Lagoe Boti, in Toba, whence the Batak who became head of the *marga* may have come, but rather in the low country where the *marga* is still strongly represented, where there are plently of crocodiles, and where pagans of the crocodile clan still say that the spirits of their dead go not to the mountains but to the river mouths, where they enter the bodies of crocodiles. The *marga* Si Boeea (or Si Boeeja) may have modified the physical type of part of the Pardembanan. The mythical father as well as the nephew of the founder of the crocodile sept had the curious name Partano, meaning one pertaining to the land, perhaps personifying aboriginal occupants of the land prior to Batak occupancy. The founder's own name means "One who invites others to share his labors" and a mythical nephew Panahara was "One who shared in another's labor." The tradition, I believe, rationalizes the incorporation of lowland aboriginals into the Batak system of marriage septs.

MALAY CONQUEST AND COLONIZATION OF THE ASAHAN RIVER MOUTH

History indicates that the coastal strip of Asahan became Muhamadan and fell successively under the sway of Malayan (Islamic) Atjeh, about 1620, and then of Siak, and undoubtedly received adventuring Malays from other states as well. In addition there came the usual scattering of Arab and Chinese immigrants, who melted into the "Malay" population but whose children may well have been born to Batak slaves. In other words, Asahan early built up the same sort of a mixed Islamic Malay-speaking population as that which supports the general Malay culture of the Straits of Malacca, the Malay Peninsula, and Indonesia in general.

Like Asahan, the Siměloengoen states to the northward of Asahan are supposed by tradition to have been originally Batak clear to the sea. Then Batoe Bara was founded as a colony of Siak by South Sumatran Malays. The original Minangkabau social structure was modified (according to the anonymous authors of the "Encyclopedic Bureau," 14) by later influence from Johore and by the impact of Asahan and other neighboring little states. Here, in 1918, the people still called themselves "men of four quarters" (*soekoe*) although the *soekoe* (sept) chiefs had generations ago become the territorial chiefs of Tanah Datar, Lima Poeloeh, Pasisir, and Lima Laras.

The administrative unit of Asahan was, in Dutch colonial days, one of several sultanates which, with the Batak lands, made up the Government of the East Coast of Sumatra. Extending, in later times, inward from the sea to the mountains, it was originally limited to the Islamic area at the mouth of the Asahan River and a coastal strip along the Straits of Malacca northward to at least the Soengei Si Kassim (one of the diversions of the Soengei Silau Toea) thence extending a short distance inland. Ethnographic evidence would indicate that the nearest of the group of Siměloengoen minor states, Tanah Djawa, was in ancient times closer in cultural contacts to early pagan Asahan than to the rest of Siměloengoen (5).

The Batak area of Asahan with the most pronounced local ethnographic characteristics (associated with the Pardembanan dialect) was merely a narrow wedge running to a point in the hilly up-country between the two rivers shown on the maps (see Joustra (17) "Kaart der Bataklanden") as Aek Silo Toea and the northern branch of the Asahan River, known simply as Aek Silo. (These are the Soengei Silau Toea and Soengei Silau of later maps.)

In the immediately pre-Dutch period the non-Islamic hinterland of Asahan had at least four principal little Batak "kingdoms," namely Bandar Poeloe, Bandar Pasir Mandogei, Boentoe Pane, and Silo Maradja. The number of independent areas was actually many more than four, depending upon the rise and decay of other village centers. These areas, except Bandar Poeloe, were all inhabited by essentially similar people, most of whom had spilled over from the mountains to colonize the lowland, and, in the reverse direction, had been, for centuries, in process of assimilation, from the coast inland, to the general Malay culture of the

Straits of Malacca, which extends from Riau Lingga northward. Bandar Poeloe, partly Pardembanan, was greatly influenced by continuing and modern immigration from Toba, because it was the chief trading point on the river for Malays from downstream and Toba (as well as Habinsaran) Batak from the highlands.

THE PROCESSES INVOLVED IN ASSIMILATION OF PAGAN BATAK TO MUHAMADAN MALAY

It was typical of ancient Malayan colonization that strongly armed and courageous Malay-speaking seafarers conquered and colonized the mouths of the rivers but did not travel much farther inland than they could go in boats. Thus each river haven of any importance, if far enough away from the next one for distance to give some security from neighbors, became the seat of a small Malayan Islamic sultanate to which inland pagan groups might be nominally more or less loosely affiliated.

We have a clear account, from the pen of the first English visitor to interior Asahan, of the violence of the warfare and slave-raiding that accompanied and accomplished "acculturation" a century and a quarter ago, before Europeans were concerned with it. John Anderson, Agent to the Government of Prince of Wales Island (Penang), Deputy Secretary to Government and Malay Translator, was dispatched in 1923 to make investigations along the west coast of the Straits of Malacca. This coast for a long distance was practically unknown to Europeans. Anderson's instructions were broadly drawn up. His objectives were to be purely "commercial" rather than "political," and gave him scope and authority for conducting ethnological and historical enquiries. His report (1) is remarkably detailed for its time and is the first to give substantial information on Asahan and Batoe Bara, as well as certain other sultanates and ports of the East Coast of Sumatra.[5] Although the mere name had been recorded earlier, Anderson gave the first account of the Pardembanan as a distinguishable group of the Batak, although it was generally disregarded in the Dutch literature, except for a few references. Anderson (1, p. 325) wrote:

> The Battas [Batak] of the Bendar Pulo [Bandar Poeloe] branch of the Assahan [Asahan] are Tubbas [Toba] who may be known by the holes in their ears. They are not cannibals. [Our author was misinformed!] Those of Munto Panei [Boentoe Pane] are of the tribe Perdimbanan[6] [Pardembanan] and eat human flesh, are indolent, addicted to opium, and always engaged in war. . . . There is a great variety of dialects spoken here, and I shall beg to insert in this place a specimen of the language spoken by the Karau-Karau [Karo] Battas in the interior of Delli [Deli] and Langkat, and of the Perdimbanan, which is the dialect spoken at Assahan. This last differs but little from the Tubba and several other dialects spoken in that quarter (p. 324).

The words of the short comparative Karo and Pardembanan vocabularies do not seem to be sufficiently well recorded to call for much comment but it is interesting to observe that the betel-nut quid is given as *demban,* in accordance with present usage, rather than *"dimban,"* which would be expected if his spelling "Perdimbanan" were correct. As to the Pardembanan Batak having been always engaged in war (quite contrary to their explanation of what their name implied!), Anderson himself supplied a very good explanation. He said (p. 321):

> Since the abolition of slavery at Pinang [Penang] and Malacca, the trade in the human species has been very much circumscribed at Assahan. In former

[5] The earlier report of Leyden (23), in 1808, recorded only the name apparently by hearsay from some rather inaccurate informant, in the following list of the "Batta" groups: "The names of the different Batta tribes of whom I have been able to hear are the following:

1. Batta Sebalungu [Batak Sibalungun]
2. Batta Padembanin [Batak Pardembanan]
3. Batta Kwalu [Batak Kualu]
4. Batta Pannay [Batak Pane]
5. Batta Toiu [Batak Toba]
6. Batta Bila [Batak Bila]
7. Batta Kurulang [Batak ka Uluan]
8. Batta Sipagabu [Batak Si Parbegu; i.e. 'pagan' Batak in general]."

Some of the names must have been badly garbled as recorded, or too illegibly written for the printer to read them, but I have indicated in brackets what they might have been. Only the renderings of the fifth and seventh may be erroneous. Some of the "tribes," however, could only be established as Batak in recent times if one made rather searching investigation. The people of the drainage basins of the Kualu, Pane (south of the Asahan River—not Pane in the Simëloengoen country) and Bila rivers generally passed as Muhamadan Malay in 1918 and 1927, but actually maintained (secretly) their Batak *marga* marriage prohibitions. They are not looked upon now as Batak, for they have almost but not quite passed through the phase of assimilation to Malay Culture in which some of the bilingual Pardembanan still found themselves at the time of my visit. In 1927 confidential questioning would still bring forth a statement from many a good "Malay" in Bila of the Batak marriage sept to which he belonged.

[6] Elsewhere (p. 226) he gave the spelling "Perdumbanan."

years, the average number of slaves exported was about 300, of which the greatest proportion consisted of females. The slaves here are generally procured in war, and the Malays do not find it difficult to make a pretense for engaging in hostilities when they require a few slaves. The Battas are averse to residing near the river's side, unless in large parties, as they are liable to be attacked suddenly, and carried off by the Malays. They never go to bathe, even, without being armed. The Malays, however, frequently seize their children straying near the banks of the river.

Since Batak female slaves retained in Asahan were assimilated to the Malay population, but were able to retain some contact with their own people, slavery was an effective means of acculturation, for Batak women, then as now, would have taught their own language to their children.

Another and probably still more effective means was by intermarriage and concubinage. Of this Anderson had something to say. Referring to the Malay chief's house at Munto [Boentoe] Panei, he observed:

> The young rajah's house is full of women, some of them beautifully fair. I saw not less than fifty good-looking girls in his house. If a Batta rajah refuse to give him a daughter, he makes war upon him, on some pretense or other, and takes them by force. The [Batak] rajah of Munto Panei assists him with men, and shares in the spoil, while his people feast upon the slain. Some of these chief's daughters of the Pardimbanan tribe (the Tubbas are the dark race) are beautifully fair.

In the following century there was little reference to the term Pardembanan in either a geographic or an ethnic sense. Van der Tuuk (29), the first great authority on the Batak dialects, interpreted the name Pardembanan as the "place where *sirih* was called *'demban.'*" This explanation was repeated by Kroesen (22), who said that the stem (*"marga"*) Karo inhabited the upper stretches of Deli and Serdang, whereas the *"marga"* Pardembanan inhabited the back country of Asahan. Kroesen, however, misused the term *marga*. A *marga* is an exogamous marriage sept, of which several (theoretically at least four, often a dozen or more) must of necessity coexist in any Batak society. The Karo *people* belong to several *marga*, of which *marga* Karo-karo is just one. In the Pardembanan country (where I have made lists of the old-established *marga* at several places) there is nowhere any *marga* Pardembanan. Properly the form of this word indicates that it should have geographic or place significance, primarily, as Van der Tuuk said, and should indicate the people or languages only by transference or adjectivally, modifying such a word as *halak* (man, person).

Prior to Kroesen's reference to the Pardembanan district, Scheemaker (26) had made a trip up the river dividing Siměloengoen from Asahan, then (and sometime still) known as the Soengei Beloeroe, but now generally called the Soengei Silau Toea (in standard Malay, but locally "Silo"). He referred to the right side (facing down stream) as Perdembanan, to the left as Siměloengoen. The existence of two names for the Silau Toea perplexed Joustra (18, p. 58), who thought that Scheemaker didn't really know where he had been! Modern maps (14, 15) show that the Soengei Silau Toea and the Soengei Beloeroe are the almost parallel north and south branches of the same river, connected above the fork by a long, oblique intermediate channel that carries part of the flow of the northern channel eastwardly across to the southern. Such a complication must have been confusing, before good surveys had been made, for the Beloeroe proper and the intermediate cross channel were entirely within Pardembanan, whereas the northern branch above the diversion was, in 1867, as it remained, the boundary river. On most maps it is the Silau Toea, but on one modern map (15) it is still called Soengei Beloeroe. This point may seem unduly labored, but the general failure of ethnologists and others to recognize the rather distinctive Pardembanan group of the Batak makes it desirable to bring the Dutch references together, even though they are few and vague.

After Kroesen's reference to them the Pardembanan Batak were hardly mentioned in the literature on Sumatra for a period of several decades. Their name barely appears in Joustra's bibliography (18) and does not occur in either edition of his summary of literature on the Batak lands, with its two supplements (17). It does, however, appear in a publication ("Sumatra Tidings") of the American Methodist Mission which was active in Asahan from about 1925 to 1935. In the long interval the Pardembanan had been disregarded as merely a transitional fringe of the Toba Batak, too much Malayanized to be of interest. Pardembanan traditions do indeed appear to indicate that most of them came originally from the country south of Lake Toba or from region of Dolok Soeroengan.

As in Asahan, many Batak in Batoe Bara were assimilated to Malay culture by conversion to Islam,

by slavery, and by concubinage, while Batak culture retreated toward the interior. Still, in 1918, after hundreds of years, a couple of signs in the Siměloegoen style of Batak script were to be seen in Laboean Roekoe and Tandjoeng Tiram, near to and at the mouth of the Soengei Silo Toewa, which signs were for the benefit of traders from the pagan back-country. Up the coast that far the Batak dialect referred to as Pardembanan appeared to prevail.

THE MALAY LANGUAGE AS A FACTOR IN RECENT POLITICAL AND CULTURAL UNIFICATION

Throughout much of the wide extent of the Malay language it has been superposed upon or has displaced related local languages, and the process goes forward today as it has for centuries. In the later decades of the colonial period schooling in standard Malay was fostered by the Netherlands-Indian Government, with the result that, more than ever before, the far-flung "Indonesians" had a *lingua franca* which fostered ideas of racial unity, which in turn supplied much of the impetus for political independence from Holland. It is a curiously significant thing that an educational program of a foreign ruling power, which imposed a common language, should have largely contributed to breaking down the colonial system. It is likewise interesting to observe that without the governmental structure erected by the Dutch, no approach to political unification would probably have come about even through the possession of a common language. In all of history there was never governmental unity in the East Indies until it was imposed upon many culturally and linguistically diverse ethnic groups by the Dutch. They forced a heterogeneous (even if related) group of peoples into some semblance of a unified political structure which the Republic of Indonesia has taken over, but which it will have a hard time indeed to maintain. The whole foundation for the new Indonesia was laid by the Dutch.

In unwittingly laying the basis for the new nation the Dutch seized upon an agency of unification and acculturation which had been operating for many centuries, namely, the Malay language. This language had heretofore been used to promote interisland and foreign trade and to propagate Muhamadanism. It was the main language of commerce, and extended at least along the coasts of all the islands. In some places it had quite supplanted the more or less closely related local Indonesian languages. These languages had a certain basic structural and lexical similarity, traceable even between those which are most unlike at first sight. They covered an area extending from Madagascar to Formosa. The Spanish conquest, the imposition of Roman Catholicism, and the subsequent course of historical events cut off the Philippines from agencies of acculturation with their Islamic neighbors to the southward, such as the Malay language and the Muhamadan religion, at a time when these had already reached and strongly influenced the islands bordering the Sulu Sea.

To the southward of the Philippines were scores of languages and dialects forming a geographical mosaic from Borneo to the islands westward of Sumatra and eastward to the Moluccas. Extending to all of them was the rapidly acquired Malay. In some small islands (Riau Lingga) only Malay was spoken, but elsewhere, at least along the coast, there was generally a fringe of Malay speakers and some degree of bilingualism.

THE MODERN "BASA INDONESIA"

This condition was gradually taken advantage of by the Dutch to extend governmental and cultural unification by using a standardized Malay in the schools. There was, indeed, much unofficial and official schooling in many other languages, partly under the auspices of Christian missions, but Malay came to be more and more the preferred medium of education. Concurrently the language became adapted to modern life by the incorporation into it of many words and usages that would be refused by Malay purists of the old school as barbarisms. In general, Malays are critical about language, and endeavor to speak correctly. The standardized modern speech is actually based upon literary Malay; discards the cruder barbarisms of foreigners, as well as the artificial, phonetically non-conforming, labored Arabicisms of religious teachers; accepts the spellings and usages of modern official publications; provides much new technological and scientific terminology. In order to minimize its essential identity with true Malay, for it is really nothing but Malay enriched to provide for modern needs, although original speakers of Malay are a minority in the population, it is now called "Indonesian," or "Basa Indonesia." The acceptance of such a term, a European invention, parallel with Polynesian, is highly significant, for it reflects the fact that, until Europeans supplied several terms, the people of the Malay Archipelago had no name for themselves in a comprehensive sense, nor for the region which they in-

habit. Such political unity as they have is almost wholly a creation of the Dutch, but their cultural unity (so far as it exists) is based largely upon the spread of Islam and of the Malay language.

One common language, instead of scores, was essential to the development of cultural and political homogeneity throughout the Dutch East Indies. Encouragement by the Dutch of schooling for natives in a language associated with assimilation of the Indonesians to a non-European Islamic culture certainly aided the separatist movement. Christian missions sometimes but not always favored the more local languages, such as Toba Batak. Greater success of the Christian missions would have retarded the unification of Indonesia, except through eventual assimilation to a more European and Christian type of culture, which might or might not have had the effect of maintaining stronger ties between Holland and the Indies. Linguistic community with Holland by encouraging the use of the Dutch language by the Indonesians unfortunately never had any extensive trial. Probably much future strife and injustice would be avoided if the Christianized Moluccas could be permitted to go their own way politically and culturally, apart from the Republic of Indonesia. They have diverged too far from the prevailing Islamic culture of the other islands to be forced into the same cultural mould. They might eventually bring New Guinea, not yet Muhamadan, into their cultural orbit, and cut off the eastward spread of Islam.

As a linguistic term, "Indonesian" has been generally applied to all of the languages of the Malayan group, including the Philippine languages and the aboriginal dialects of Formosa as well as Malagasy and related dialects in Madagascar. From all of these Brandstetter was able to pick out quite obvious common components, which have been called Common Indonesian, and by comparative studies, both phonetic, and, so far as possible, historical, he started the reconstruction of Original Indonesian, a work which was continued by Dempwolff (10). The term "Indonesian," of European manufacture, has, for reasons of politics and nationalist propaganda, been preferred to "Malay" for the basic Malay with superstructure of borrowed words and syntactical usages which are designed to adapt it to modern international life. The new "Basa Indonesia" since about 1930 has been propagated by writers of Malay of the new school (largely by Sumatrans) and, of course, far more intensively since 1945. It is intended by the politicians that it shall entirely supplant the older native languages and dialects of the islands, in accordance with the nationalist slogan: "One fatherland, one people, one language." The course of development of the Indonesian language (in this new political sense) has been admirably traced by Drewes (11), and its word content and syntax indicated in several works, of which one is that of Emeis (13).

BILINGUAL FOLK LITERATURE IN ASAHAN

A quarter of a century ago Silo Maradja well exemplified the slow acculturation of a localized inland pagan population to the generalized coastal Malay culture, which is now becoming a generalized modern Indonesian culture. The process has had historical record, even if scanty, since about 1600.

Since bilingualism is so common in Indonesia it should interest students of ethnology and language to have a bilingual sample of a traditional type of oral literature from this restricted area, in which Malay and a local language exist side by side, the latter losing ground to the former. It must be explained that such a manuscript as that which I present, a chant recounting commonplace events in the yearly cycle of cultivation of upland rice, upon which the forest-dwellers depended, and with social events such as betrothal of the young people and house-building, would never ordinarily have been written down at all. It would have been carried in memory and modified from year to year in accordance with special occurrences of the year. As written for me by Lobih Hasan, the volunteer Muhamadan "missionary" and teacher, it was modified by reference to particular events of a festival, at which I was the invited guest, to whom, as well as to their children, the villagers were attempting to teach the rudiments of good manners and correct speech.

A chant or monotonous song of the sort that was recited and then written down for me in two dialects is called *"ende-ende,"* which means "a kind of a song." It was designed to instruct children in essential folkways, and, at the same time, to begin to convert them to Islam by teaching them to use Malay instead of the local Batak dialect, which is associated with old pagan beliefs. It is an example of a type of primitive, ordinarily unwritten, literature of which an indefinite amount might be collected in Indonesia if anyone had the time and inclination.[7]

[7] I venture to make this statement in spite of having found no exact counterpart elsewhere for this chant. The explanation would seem to be that even though such chants are traditional, their content is so informal

This chant is interesting in several ways. (1) It affords a glimpse of the informal but effective type of group education that has probably existed in an unschooled society for thousands of years. Children in primitive society learn by helping their elders, by participating in community work, by asking questions, and by imitating in their play the activities of their elders. Then (if Silo Maradja was typical) the more essential activities concerned with the annual cycle of agricultural operations, housebuilding, and the like, were interminably reviewed at harvest and sacrificial feasts and lesser gatherings in freely varied chants and tales. In our particular instance, those participating were the pagan priests, the exponents of Islam, or anyone else who had the inclination and could hold his listeners. The chanters often cooperated with the best of good will, taking turns with one another, although the objective of the pagans was to maintain an old culture and that of the Muhamadans was to wean the children away from it. (2) In the particular bilingual community dealt with here, the educational chants were recited in both the old, local language and Malay. Parallel texts provide linguistically interesting material to anyone who cares to concern himself with the characteristics of local dialects, the geographical and evolutionary relation of such dialects to older or more wide-spread forms of speech, and the interaction upon one another of co-extensively used languages. (3) As already commented upon at some length, the study of bilingual communities in Indonesia gives an idea of the past and continuing importance of language change in the assimilation of local cultures to the generalized Muhamadan Malay culture. The gradual adoption of Malay, a centuries-old process, encouraged by the Dutch, became one of the chief factors that resulted in the setting up of the Indonesian Republic.

The bit of folk literature which I present with this unduly lengthy discussion of background is a chant recited or sung at agricultural festivals, with the idea of teaching the children about the importance of the yearly cycle of events which must be carried through on schedule by a people depending upon the very primitive agriculture of growing dry-land rice in forest clearings.

The background for such a chant must be thought of as any gathering of the people, such as the festival of the rice harvest. It lays emphasis on the good fellowship at the festivals, a reward of community labor. The chant begins with an exhortation to forget idle pleasures and get to work. The old crop is about gone, and the time for planting has come. The events leading up to departure to the place chosen for the upland rice clearing (*djoema*) are swiftly recounted. Then follows the story of chopping underbrush, felling big trees, burning of debris, planting, weeding, harvesting, a hint of the observance of the cult of the rice-soul, the harvest celebration, and the arranging of matches between the young people. The youths

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and fluctuates so much from occasion to occasion that the *"ende-ende"* alluding to a particular time would not be deemed worth writing down. Since his own chant is definitely classified by Lobih Hasan as *"ende-ende"* (a kind of *"ende"*), its place in the general classification of Batak literature is at least clear. Warneck (34) makes no distinction between *"ende"* and *"ende-ende,"* indicating the type of composition so called merely as "song." Joustra (18) discussing literature of the Batak, and Overbeck (24) for Indonesia in general, have said that European linguists have recorded only a slight amount of what exists in the way of tales, riddles, proverbs, *songs*, etc., that live in the mouths of the people and that can rightly be called folk-literature. This is certainly true of all the Batak dialects, including Pardembanan. Only more formal types of composition are likely to have been written down and to be found in a set wording. Of ordinarily *recited* folk literature in Mandailing Batak, Joustra (17) distinguished (*a*) prose tales, related in the manner and tone of ordinary speech, namely, *hobar-kobaran*, and (*b*) poetic prose recited in the manner of song, namely, *toeri-toerian*. The latter, thrown into 4-lined verse with assonance, generally of the beginning of the first line with the beginning of the third, and of the beginning of the third, and of the beginning of the second with the beginning of the fourth, constitutes the Mandailing *ende*. Van Ophuijsen (32) has published examples of such Batak verse. Nevertheless, I believe that, if chanters or singers at folk festivals were not too self-conscious to perform, a vast quantity of longer compositions of a more spontaneous sort could be picked up almost anywhere by using a tape recorder. I suspect that this would be true throughout the more rustic parts of North Sumatra, although a recent monograph gives no evidence of it, curiously enough, for Atjeh, where the folk literature seems to have become artificial and stylized under unusually strong Muhamadan and Arabic influence. I refer to the interesting review by Van Waardenburg (33) of the influence of agriculture on language and literature in Atjeh, but one gets the impression even from this that published materials may not have reached out to the fringes of spontaneous folk literature, since the literary compositions cited or translated bear such a heavy burden of Muhamadan religiosity. I have searched farther afield, in the ethnographic literature on Borneo, where poetry is important in the ritual connected with agriculture, but even there the published examples are of a more formal sort. The poetic compositions of the Dyak, like the previously published *ende* of the Batak (see van Ophuijsen (32)), are short, mostly quatrains in the style of the Malay *pantun*. See the publications on customs and ceremonies connected with rice-growing by Schadee (25) and Elshout (12): many other writers might be cited.

and their parents are reminded that harvest time is a proper time for weddings. The chant slides rather abruptly into the related topic of house-building, a proper activity for a young man about to set up a new home but difficult of accomplishment because of the varied materials needed, all listed by name. Emphasis on the difficulty of assembling them is calculated to impress the young man with the responsibilities of married life, and also to stimulate his friends and elders to help him.

Although such a chant follows a traditional pattern, the reciter proceeds more or less *ad libitum*. So it ends with amusing indication of the manner in which the people expected to entertain me, namely, by instruction in the "village speech." Coupled with it is a most polite intimation that any little gifts that I might be inclined to contribute would be gratefully received.

Lobih Hasan wrote both versions of the chant in Batak script as part of a group of compositions that he hoped would serve me as a "study book." As I try to translate it nearly a quarter of a century later I wonder what has happened to him and the other good friends of years ago. I understand that many were killed and scattered during the War and its aftermath and that things will never again be the same in the jungle village that received an American visitor so kindly and hospitably. I have the fondest memories of Silo Maradja. Doubtless a school teacher had come in the years between 1927 and 1942. The people had indeed built a school late in 1926, in the hope that it might serve as bait to entice a Government teacher to them, and a Malay teacher was actually assigned, but was recalled after only a few days when "outside influences" had removed themselves (or himself!).

So our bilingual chant is an example of the sort of instruction by which the children of a schoolless and scattered community were brought up to understand and follow some of the ways of their forefathers, but also to prepare them, by accepting Islam, to break away from some of the old ideas. Presumably, such a chant would have been recited years ago only in Batak. We may think of it as a survival from an early stage in the history of education. The same sort of thing may survive in many countries down to our own time in remote places where education by imitation in children's play of the activities of their own immediate families is supplemented by the ceremonial observances of the older people. Listening at folk festivals to endless chanting by any *"goeroe"* who felt called upon to do it (but especially by the *datoe,* the "magician-priest") constituted much of the education of the young, and such chanting was especially in order on the completion of some community work. As the several *datoe,* chief and lesser, chanted in Batak for the pagans, Lobih Hasan and other self-appointed Muhamadan missionaries took turns with them in chanting Malay, teaching the more wide-spread language and propagating Islam. The title Lobih is the rendering in "village speech" of standard Malay *lebei,* the designation of a subordinate volunteer Muhamadan teacher.

SPELLING AND TRANSLITERATION

Since the basic Toba dictionary of Van der Tuuk (21) is inconvenient to use, because it is arranged according to the Batak order of the syllables, I have generally saved time by consulting that of Warneck (34). The latter, supplemented by the convenient Dutch-Toba vocabulary of Stap (27), has been sufficient for finding Toba equivalents for most Pardembanan words.

It must be realized, however, that, even if immediately recognizable Malay and Toba cognates can frequently be found, it by no means follows that these cognates would ordinarily be used everywhere or even understood. In both Toba and Malay there are many synonyms, so that parallel meanings are often expressed by very dissimilar words in these two languages. Karo may provide a cognate for a rare Malay word when Toba does not. The few Karo words which I cite are from the dictionary of Joustra (20) and a rather extensive manuscript vocabulary made in 1918 with the help of one informant only, Galoengi *marga* Karo-karo Sinoelingga, a studious and diligent Karolander who then helped me in botanical collecting. In getting at the meaning of words used in Asahan, either in local Malay or Pardembanan, I have seldom gone beyond the published works mentioned, but I have made use of a very limited manuscript Simëloengoen-Malay vocabulary drawn up by another native helper, Bidin *marga* Si Rait Holboeng (a Pardembanan Batak), and a more extensive vocabulary of Angkola Mandailing written for me in 1918 by another assistant and good friend, the late Marah Tigor Nainggolan of Si Pirok.

With the help of Bidin and numerous other informants I made a useful Pardembanan-Malay vocabulary in 1918 and 1927, but every piece of manuscript presents words which are additions to it, or variants of words recorded in slightly different spelling. The chant presented herewith and

FIG. 1. The first page of Lobih Hassan's manuscript. The arrangement of the heading is in imitation of Malay books published in Singapore and Cairo by lithographic reproduction of manuscript written in Arabic characters. In the Pardembanan area this somewhat characteristic variant of the ancient Batak script was used for writing both Batak and Malay, because few converts to Islam had ever learned to read Arabic script. The Batak text is in the left column: the Malay on the right. The middle is just a repetition of *artinja* ("the meaning of it"), and illustrates the non-avoidance of the character for *nja* (*nya*), used in the sub-Toba dialects but not in Toba. The first few horizontal separation lines and the vertical ones are the repeated *ja* (*ya*) character traditionally used to separate the parts of manuscript scratched on bamboo.

FIG. 2. Another page, beginning (Batak, upper left) *beta laho martandang* and ending (Malay, lower right) *soepaja lakas dapat saja*. On this page the middle column is a repetition of *ja itoe* ("that is [to say]"). It exemplifies the use in Pardembanan and some other sub-Toba dialects of the character for *ja* (*ya*), which is seldom found at all in Toba manuscript and never as an initial.

other similar bilingual texts have enabled me to add considerably to it, since the Batak and Malay texts in general have precisely equivalent words. The reader will note a few exceptional lines that are not exactly the same in meaning. Whenever the difference might be perplexing, English is given for both.

If words are contained in the Toba dictionaries in the exact form in which they occur in the text, they are omitted from the glossary. Although there are several Malay dictionaries which present "standard" Malay of the pre-war schools I have relied upon that of Badings (4), not because it is necessarily the best, but because it was so generally at hand in Sumatra.

Since the vastly greater amount of literature on languages and dialects of Indonesia uses the Dutch spelling I have adhered to it. Therefore I have retained *"oe,"* except for keeping the greatly preferable *"u"* to indicate words taken from Warneck's dictionary.

It may seem reactionary to use the old and clumsy spelling, but the actual texts of this paper will never interest anyone who will not be thoroughly accustomed to the Dutch spelling, which so dominates the literature that anyone must be familiar with it who delves at all into Indonesian dialects. It must be pointed out that one who concerns himself with the contemporary interactions of modern Malay and other Indonesian languages will find indispensable the older dictionaries of what purports to be "pure" Malay, as opposed to the rapidly growing synthetic vocabulary of new Malay which it is newly styled as "Indonesian." A few years will now bring about as much change in Malay as generations have in the past, for schools and periodicals have rapidly abandoned the more conservative older speech.

The matter of transliteration has presented no difficulties, for the Pardembanan Batak write exactly as they pronounce. If a word contains double *t*, two *t*'s are to be clearly pronounced. The first is the end of one syllable and is a phonetic substitute for another consonant. The second is the beginning of the next syllable. Linguists need not to raise their eyebrows or turn up their noses at the double *ng* of *noengnga*. It is correctly spelled exactly that way by those who do not elide when two *ng*'s come together. The sound is that of *ng* as in "sing," clearly and definitely pronounced twice. The same is true for the double *s* in such a word as "kissil." This warning seems necessary, for there is nothing that gives a simon-pure linguist a greater feeling of innate superiority than questioning the spelling of source materials, if they were gathered by a non-professional or before the days when philology had given way to phonetics and phonemics.

I have not transcribed the counterpart in Batak script of *hamzah* occurring as an initial. All words alphabetted under *"a"* or other vowel would more correctly appear as *'a, 'e, 'i, 'o, 'oe* (*'u*) but this practice has not been customary and seems unnecessary. Final *hamzah* is indicated if spelled. The Pardembanan do not perplex us by avoiding initial *"w"* and *"y"* (the latter written, according to Dutch spelling, as *"j"*). Initial *"w"* is really *"w,"* not *" 'u,"* and initial "y" (*j*) is not *" 'i."*

MALAY AND BATAK TEXTS, WITH ENGLISH TRANSLATION [8]

M ini tompat barladjar sakhap oerang kampoeng ende-ende jang lobih bagoes sakali kita barladjar dini

This is the place to study the speech of the village people. A chant that is the very best of all, we study here.

B sirang [9] do hape na sirang-sirang sirang sassogot oelaing lagi roesak tartawa lagajada

[8] B = Pardembanan Batak: M = Malay, village dialect of Asahan, called MA in the glossary.

[9] This initial passage would seem to be an allusion to one of the duties of the *datoe* that once implied some astronomical observation, but now does so no longer. The original migration to the eastward was from Toba. The horizon to the eastward was the place of the rising sun, "habinsaran," to the Toba people, but it came to be a fixed geographic term, applying to the mountainous rim to the east from Toba. Passing this mountain border country, the colonists in the eastern lowland looked back to the westward upon Habinsaran, the land of the rising sun! Their astronomical ideas may have become confused, for *sirang* became a poetic word for the areca palm, rather than expressing the idea of "things separated that belong together." The *datoe* had to announce to the people that the position of the stars indicated that the time had come for commencing the preparation of clearings for planting the upland rice. The following clues to the matter are from Hoetagaloeng (16, pp. 9–10):

"Ia bintang na doea on anak ni boelan do. Sioela haoema do si Pariama, djala na boerdjoe; alai hagigian do i di inana. . . . Alai atik pe sirang na doea i. Ia di ari hoeroeng, di hasoendoetan ma bintang si Pariama toe hasoendoetan manogotna i. Alai sai holan ihoer ni Sialasoengsang do idaon ni si Pariama, songon i Sialasoengsang holan lailaina do boi tataponna. Maroedjoeng do parsalisian ni na doea i, ndang olo sae. (Di parnangkok ni si Pariama do didok datoe, soeanon gadong, eme; asa ramos.) Ai di moellop oeloe ni si Pariama di habinsaran, pintor marimpotimpot do Sialasoengsang maporoes toe hasoendoetan. Molo padjoempang nasida ro ma adjal ni tano on."

"There are two stars that are the children of the moon. He who is the one concerned about the rice field is Si

Betel-nut it surely is; a special kind of betel-nut, betel-nut of morning bright. There must be no more idling, no more giggling, and such! Quite the contrary!

M pinang do hape pinang-pinang dijatas dolok doelang lagi roen djattartaran lagi lata
This is betel-nut indeed, the kind of betel-nut at the top of the mountain! Let there be no more dilly-dally, no more giggling, no more silliness!

B beta hita moelak

M mari kita poelang
Come, let us return home.

B toe djaboe hita djolo

M ka roemah kita doeloe
To our house, first of all.

B tole hita mangan
Let us get on with our eating!

M mari kita makan
Come, let us eat!

B ase gira hita laho
so that quickly we may go

M bijar lakas kita pigi
Getting through quickly so we may go

B mardalan-dalan toe kode
as though out for a stroll to the shop

M malansoeng-lansoeng di kede
going as though walking for pleasure [10]

B mamboli paroegas hita

M boewat boli barang-barang kita
so as to buy our goods.

B hita boli djolo babar
We shall first buy cloth from the bolt.

M Kita beli doeloe kaen tidoer
We shall first buy sleeping cloths.

B landjar hita boli pinggan
Right away, then, we buy plates.

M toroes kita beli piring
Straightway we shall buy plates.

B baroe pemoelak hita toe djaboe

M baroe kita poelang di roemah
Immediately after, returning to the house,

B mardahan ma hita djolo

M masa' nasi kita doeloe
we then cook rice.

B noengnga salpoe mangan
That having been done (we) eat.

M kalo soedah lopas makan
When that is done, eat!

B lahoho ma hita toe harangan mangimas
We go to the second-growth jungle where the brush is to be cut.

M pigi kita tamasoe' hoetan manobas
We go. We enter the forest that is to be cleared.

B noengnga diimas dirobo ma
When the brush has been chopped, the felling is to be done.

M soeda ditobas ditobang lahang
When we have done the felling, big branches are to be chopped off.

B ba hita rapot ma
What? Done? We shall come together for conference.

M mari hita potong-potong
We come to the chopping.

B ase gira horing hita soerboe

M bijar lakas karing kita bakar
May it quickly dry so that we may burn it!

B tole mangahoet hita poeran i
Come, let us do the clean-up burning! There will be betel!

M mari kita koempoel kita bakar
Let us gather together! Let us burn it!

B tole hita hisir robat on
Come, let us move away the obstructions.

M mari kita sapoe sampah ini
Let us sweep up this rubbish!

B noengnga sa'e hita paoeli djoema i
That done, we decorate this clearing.

M soeda sijap kita barsilang itoe
That done, we make the crossed-stick barriers for it.

Pariama, the trustworthy, yet he was repugnant to his mother. . . . However, because it was so, the two (brothers) had to be separated. . . . On the last day of the twelfth month the star Si Pariama was caused to go down, to sink out of sight at the place of its going down. Only the tail of Sialasoengsang (the one named Upside-down-cross) showed where Si Pariama had gone, like a long tail-feather at a distance showing well where he was. So long as the two are separated, assent for the field clearing is forbidden. (At the rising of Si Pariama the *datoe* is to say that then the yams and rice are to be planted, so that they may be productive.) When the head of Si Pariama appears at the place of the rising of the sun, only then is Sialasoengsang far away, fleeing to the rising place. When that happens they go about the preparation of the land."

[10] As used by Malays the Javanese expression *marlansoeng-lansoeng* definitely implies walking about with no especial objective. The Chinese shopkeeper is not to know that his customers are about to leave, and be tempted, because they are in a hurry, to hold out for a high price! There has already been much talk about what to buy, and it has been decided to get sleeping cloths and plates. Plates are used only on important occasions, but are hung on the wall in open-work rattan basketry holders, as visible signs of wealth. Their ultimate fate is to be placed on the family graves as receptacles for offerings to the spirits of the dead.

B beta djolo manareja pedan
M mari kita minta' toeloeng sama pedan
Come! We ask the help of our friends.
B tole mangordang
Let us get at the sowing with planting sticks.
M mari kita tanam padi
Let us go about the planting of the rice.
B djolo mangan ma hita ase gogo harodja
M doeloe makan kita bijar koewat kadja
First we eat so that we may be strong for the work.
B noengnga sa'e djoemata nijordang
Already prepared is our clearing to be planted.
M soeda sijap kita tanam padi
That finished we plant the rice.
B noengnga toeboe emetta
M soedah toemboeh padi kita
As soon as our rice has sprouted
B marbabo ma hita djolo
we start weeding right away.
M boewang roempoet hita doeloe
we begin throwing out weeds.
B Mamoero apporik hamoe
You have to scare away the rice birds.
M djaga boeroeng kamoe
You guard against birds.
B manoewan i ma hami djolo
Up to now we have done the planting.
M manjisip kami doeloe
We have already made offerings in cleft sticks.
B noengnga barboewa emetta
Now our rice has gone to seed.
M soedah barboewah padi kita
Now that our rice has formed grain
B hita ramotton ma
we take the best care of it.
M ki(ta) djimatkan lah
We put a magic charm upon it.
B oenang diboewat aili
so that the wild pigs shall not get it.
M djangan diambel babi
so that the pigs shall not get it.
B marlangat ma emetta
Our rice ripens.
M ampir koening padi kita
Our rice turns yellow.
B kita paoeli djolo barandang inganan ni eme
We beautify the readied rice granary with torchlights.
M kita bikin doeloe tompat padi
We make the rice granary beforehand.
B mamoetak i eme ma hita djolo
Then the evil-averting dance is done before the rice.
M kita moela ambal padi doeloe
We then start with the ceremonial rice procession.
B mangotam ma hita
M potong padi kita
We cut the rice.
B toroe mago moelani toe djaboe
The curse set at naught, (we take) the source of its being to the house.
M angkat gaggamana padi itoe ka roemah
We take the harvest-soul of that rice to the house.
B mardege ma hita djolo
Then we tread out the rice.
M mansoesi padi kita doeloe
Then we clean our rice.
B mandjomoer hamoe hari milas
M djamoer padimoe ari panas
You dry your rice on a hot day.
B noengnga mapir djomoer
When it is already dried to hardness
M soedah karing padi
When the rice has become dry
B mandoeda hita djolo
M manoemba kita doeloe
we then stamp it.
B sege hamoe boras i
You winnow that rice.
M indang kamoe boras boewang padi
You winnow the rice, throw away the straw.
B pagara djolo api
Then kindle the fire.
M pasang doeloe api
Next, build a fire.
B marasi daboewan
M soekat baras dalam parijoe'
Measure out rice into the pot.
B ase mardahan
M bijar masa' nasi
Let the rice be cooked!
B aha baenotta bikkaoe
What shall we do for a savory?
M apa kita bikin sajoer
B boli ma djolo goele
Well, buy something tasty right away.
M boli la doeloe ikan
Surely buy salt fish first of all.
B noengnga dapot goele
M soedah dapat ikan
Having got the fish,

B toetoeng ma djolo ase hita pangan
M bakar doeloe soepaja kita makan
then toast it so that we may eat.
B noengnga bosoer
M soedah kajang
It is already satisfactory!
B ro hamoe toeson tole mangan
M mari kowe datang makan kita
Come you! Come to our meal!
B laho toedija hamoe
Go wherever you wish.
M maoe pigi mana kamoe
You may want to go somewhere.
B naeng toeson mardalan
You may want to come back here
M maoe pigi sana bardjalan
or may want to go there.
B aha na dialop
Whatever is asked
M apa mahoe diambil
Whatever you want is to be brought.
B roho toeson hoendoel-hoendoel hita
M datang ko'e kamari doedoe'-doedoe' kita
Come you here, we are sitting down.
B markomboer-komboer hita djolo
M barsakkap-sakkap kita doeloe
Next let us chat.
B olo do ho mangadjar ahoe soerat batak
You wish that I should teach you Batak writing?
M mahoe kamoe madjar saja soerat Batak
B bahen ma sisijasija
M bikin doeloe abese
First make the alphabet.
B pagara palita i ase tijoer hoeida
M pasang lampoe itoe bijar torang saja lijat
Light that lamp so that I may see clearly!
B bolas ma(di) dipahe
Good! it serves well.
M boelih la dipake
It can be used.[11]
B marose ma ahoe mangida on[12]
That is excellent! May I see it?
M soeka saja malijat itoe
I wish to see that!

B bere ma i di ahoe
Offer it to me!
M kasi lah itoe sama saja
Give it to me!
B hoepangindo ma di ho i
M saja min[ta']lah sama kamoe itoe
I ask it of you!
B anggo olo do ho mambere
If, indeed, you say "yes," then offer it.
M kalo maoe kasi mangkasi
If you wish to give it, then give it.
B ala gondang olo ho oenang ma
If, however, you do not mean "yes," don't do it.
M kalo timaoe taroesah lah
If you don't wish, there is indeed no need.
B adong ro oembe'-oembekkoe
My special guest has come!
M ada datang sajapoenja tamoe
My guest has arrived!
B beta maridi
Let us bathe.
M ajo kikita mandi
Let us bathe together!
B mambasoe hijoe dape hita
M manjoesi kaen lagi kita
Let us also wash our clothing,
B djomoerhon ma djolo
then dry it.
M taroeh di panas doeloe
then put it in the heat.
B hirehon ase horing
Spread it out to dry!
M boeka kaen bijar karing
Spread out the cloth so that it can get dry!
B dokkon ma argana hoebege
Tell now. I would hear the price of it.
M harganja saja dengar
I would hear the price of it.
B ninna roham sadija
He says: how much would be your idea?
M ko'epoenja pikir barapa
Your idea would be how much?
B na takkoep na roham
What would accord with your idea?
M jang patoet ko'e pikir
What would be correct, do you think?
B ho pe oenang taloe ahoe pe oenang taloe
So that you wouldn't get beat and I wouldn't suffer.
M ko'e djangan kalah saja djangan kalah
So that you mustn't lose and I mustn't lose?
B noengnga milas ari

[11] With reference to writing-bamboo and knife to inscribe it, handed to him by the *radja*.

[12] With reference to offer of paper and pencil instead of the bamboo and knife. In writing his chant for me Lobih Hasan threw in this passage and some others that fitted only one occasion. The "guest," several years before, had secured hundreds of joints of bamboo manuscript from Silo Maradja and wished further literary accessions to be in more compact form!

M soedah panas hari
The day has become hot.
B maromboes do alogo
A sudden storm breaks.
M bartijoek angin
The wind blows up.
B noengnga ro oedan
M soedah datang oedjan
The rain has come.
B ro do oedam milalas
M datang oedjan hari panas
The rain of the hot days has come,
B taho doras na
a sudden downpour.
M baja karasnja oedjan
It is a flood, a rain of the strength of this.
B noengnga sijang oedan
M soedah torang oedan
The rain has cleared up;
B noengnga massadi
M soedah baranti
it has ceased.
B olodo ho mambere boroemi di anakkoe
So you assent to offering your daughter to my son!
M ko'e ma'oe kasi ko'e poenja ana' parampoeen sama sajapoenja ana' kawen
You wish to give your daughter to my son in marriage.
B olo do ahoe mambere ala maol balandjana
M mahoe saja kasi tapi mahal dijapoenja antaran
I wish to give her, but her wedding gift must be higher.
B sadija dokko nommoe
How much do you say: tell!
M barapa kamoe bilang
How much do you say?
B nikkoe balandjana doewa poeloe tail
I ask for her wedding gift twenty pieces of gold.
M saja bilang antarannja onompoeloe ompat roepija
I ask for her wedding gift sixty-four rupees.
B tapi djaboe hoepangido sada banggal
But a house I demand, a big one,
M tapi saja minta' roema satoe jang basar
Moreover, I ask a house that is big,
B ala hambing sada
M dan kambing satoe
and a goat,
B djoema sang lambar
and a forest clearing that is broad.
M ladang satoe hole
and a forest clearing made ready by everybody's help.
B hoepalolo ma i soede
I'll erect the house completely,
M saja kasi itoe sama-sakali
I'll give it, the whole of it at once,
B nikkahon ma dohot anakkoe
if wedding be agreed upon with my son.
M kawenkanlah sama sajapoenja ana'
if she is to be wedded to my son.
B hita porima ari na oeli djolo
We must await a propitious day first.
M kalo bagitoe kipili hari jang bagoes doeloe
If so, then a suitable day is first to be chosen.
B ase hita nikkahon
M bijar kita kawenkan
Let us then arrange the wedding!
B ro ma hamoe toeson
M datang lah kamoe kamari
You be sure to come here.
B toemapang ma hita
M barsama-sama kita
We together
B ase lekket
M bijar bagoes
will arrange it well.
B padjolo hamoe mamoelak
M doeloekan kamoe poelang
Get things started by you returning home.
B dipoedi ma hami ro
M dibalakang kami datang
We shall come along behind.
B na ro tijan dija do hamoe
M kamoe datang darimana
You arrive from anywhere at all.
B hami ro tijan hoeloewan
M kami datang dari oeloe
We shall come from upstream.
B aha do dibowakko
What shall you have had brought?
M apa ada kowe bawa
What is it that you will be bringing?
B naengna martandang sa djolo sadjo do?
He just wished to go for pleasure only.
M soeka bardjalan sadja
The whim was to journey for pleasure only.
B naeng mangin(da) i datoe
M maoe sari datoe
He wishes to look for the priest.
B ben aha datoe
M bikin apa datoe
What will the priest do?

B naeng mori ari padjong-djong djaboe
We want him to choose a day to erect the house.
M minta' pili hari maoe badirikan roemah
We'll ask him to choose a day; we want to erect the house.
B aha ma debaho sejana baen djaboe
What indeed might you have to spare for him to build the house?
M apa-apa parkakas bikin roemah
What are the materials for making the house?
B basiha
M tiang
Main upright posts;
B pator
girders;
M kajoe jang tarikat sama tijang dibawah
timbers that are connected with the main posts, below;
B toetoep basiha
M kajoe toetoep tijang
(horizontal) timbers (lying the long way of the house) on top of the main posts;
B bondoel
main 4 horizontal house timbers at threshold level;
M kajoe jang boelat koeliling diatas lante
timbers that run around circumference above floor;
B panoekkot
the cut-off house posts;
M saporti tijang kajoe pendek daribawah
timbers like the main house posts, but short, below (and supporting floor);
B goelang-goelang
the round timbers supporting the floor boards;
M tompat galang lante
support for the floor;
B djarijo
evening-up wedges to go between the round timbers and the floor boards;
M tompat lante
the (smaller) floor supports;
B dasor
M lante
the floor;
B tohang
the upper main timbers between the main posts;
M kajoe jang tarlantang diatas kapala tijang
the timbers that cross the open spaces between the tops of the main posts;
B larijan tihoes diatas tohang
the rat runways resting on the upper house beams;
M larijan tihoes diatas tohang
B pamoltok
M goeloeng-goeloeng
the timbers forming the gable apex;
B hasodjattan
the rafters;
M kajoe jang badiri diatas tohang
the timbers that rest on the upper frame beams;
B boekkoelan
the ridge-pole;
M doedoengan
B taoep
thatch of palm leaf.
M atap
B beta laho martandang
Let us go visiting.
M ajo kita bardjalan di roemah oerang
Let us take a walk to people's houses.
B mangaha ma hita toesi
M apa maoe bikin pigi sitoe
Whatever we wish to do, let us go there.
B hita tangi-tangi halahi markomboer i
M kita dangar-dangar oerang itoe sakap-sakap
We shall hear the people chatting,
B margoeroe ma hita sakkap kampoeng
M bagoeroe kita sakkap kampoeng.
instructing us in the village speech.
B ase malo hita marsakkap kappoeng
M bijar pande ki(ta) sakkap kappoeng
Let us become skilled in the village talk
B tapi oenang magandjang-gandjangtoe
but without going into it too far.
M tatapi djangan tarlampoe pandjang.
B dang koeboto otihotik ma baen
I don't know how to do more than a little.
M saja tida' tahoe sikit-sikit sadja bisa
I don't know it; only a little can (I use).
B ase oera dapottoe
That I may get it easily,
M sapaja moerah dapat saja
So that I may get it cheaply,
B ala pabowa artina
be able to explain the meaning of it
M tapi kasi taoe dijapoenja arti
but (still) give knowledge of the meaning of it,
B (Hi)ta ibaen moersakkat-sakkat
we will make an agreement about it,
M bikin rol
(we will) make an understanding,

B ase oenang marsada
M sapaja djangan barsatoe
so as not to be lonely,
B ase oenang hadepo ahoe
M sapaja djangan ganggoe saja
so that I won't be doubtful,
B ase gira dapottoe
M soepaja lakas dapat saja
so that I'll accomplish it quickly!

GLOSSARIES OF ASAHAN DIALECTS

Believing that this paper will be more useful to the linguist if differences of local usage of both Batak and Malay are pointed out, I have prepared two glossaries of enough words to illustrate the general nature of deviation from the language of Toba, on the one hand, and from standard Malay, as exemplified by Badings dictionary, on the other. Variations of Toba are likely to be particularly interesting to linguists in view of the use of this language by Dempwolff (10) as one of the three which he considered representative and upon which he based his reconstruction of Original Indonesian.

Differences of the Pardembanan "sub-Toba" dialect from Toba proper are in simplification of grammatical structure (not indicated by a glossary) and in rather consistent phonetic changes, such as the occurrence of *a* in certain positions instead of *o*, *k* instead of *h*, the complete replacement of consonants in certain positions which in Toba may not be retained in speech but are kept in spelling, and the adoption of Siměloengoen and Malay words. Characteristic of Malay in "village talk" is the general use of *a* or *o* for *e*, of *e* for *a*, of *s* for *tj*, of *d* for *dj*, the functional use of prefixes, infixes and suffixes which hardly persist in standard Malay except in "frozen" forms (doubtless under the influence of Batak), and the free use of adopted Batak words (which may sometimes be archaic Malay) instead of the usual Malay equivalents.

Marden wrote a pioneer Malay dictionary and a grammar in which he spelled many words of Sumatran Malay with *a* in place of *ĕ* of modern linguists. Some later writers have believed that his feeling for vowel sounds was defective, and have disparaged his work accordingly. It is therefore interesting to find a persisting Sumatran Malay dialect which not only confirms some of his spellings, but in which the spelling is recorded by the speakers themselves in an alphabet (Batak) in which there is provision for precise indication of the vowels. Anyone interested in further phonetic or lexical comparison of these dialects will find some additional data in earlier articles by the writer (6, 7) on words for color and words used in magic and ritual.

In the following lists M denotes standard Malay; MA, the Malay of rural Asaban; T, Toba Batak; P, Pardembanan Batak; Jav, Javanese; K, Karo.

A. WORDS FROM THE BATAK TEXT

ambal mambal (P) membal Jav., sway, spring up and down in formal processional dance, with which honored guests are escorted to their places at a ceremony.

apporik (P) amporik (T), rice-bird. Illustrates the change of -mp- to -pp-. Toba retains the spelling and varies in pronuciation. In Pardembanan both *p*'s are clearly pronounced.

babar (P); kaen tidoer (MA), kajin babar (M), sleeping cloth, blanket; babar (M), cloth in an uncut bolt or as cut from same.

baenotta (P), bahenonta (T), . . . to be done by us. . . .

barandang (P), ornamented with torches (or candles), bar- + andang (M), torch.

barsilang (bar- + silang) (P), closed to traffic or forbidden to be entered; silang (P), crossed sticks in the form of an ×, warning against trespass in a place closed for holding ceremonies, for setting traps, or because of contagious disease; silang (M), crossed (as swords).

bartijoek (P, MA) (verbal formative bar- + tijoek, gust, blowing), tioep, mĕnioep (M), to blow.

basiha (P), tian (MA), tijang (M, T), tiang (M), upright post, pillar, upright main post of a Batak or Malay house.

benaha (P), contraction of baen or bahen aha, "doing what"?

bikkaoe (P), ingkau (T), bengkaoe (K), greens or other food to eat with rice.

boekkoelan (P), bungkulan (T), ridge-pole.

boero, mamoero (P, T), boeroe (MA), scare away birds; boeroe (M), to chase, drive away, follow.

bondoel (P, T), bendoel (M), four main horizontal side timbers of a house, at threshold level; therefore (sometimes) threshold.

daboewan (P), daboean (T), correct amount of rice to be cooked in a given pot or for a given number of eaters.

dape (P), dope (T, K), also, yet, moreover.

deba ho (P), *cf. ho daba* (T), while you; you, in the meantime,

diimas (P). See *imas*.

djoema (P), hauma (T), forest clearing, chiefly for planting upland rice; dry rice field.

djomoer (P, T); djomoerhon (P); djĕmoer (M), to sun-dry, dry, to dry. Warneck confines the use of the word djomoer in T, to "damp rice," i.e., rice to be dried. In P it applies to anything damp that is to be dried.

dok, dokkon (P), dok, mandokhon (T), tell, say, speak.

emetta (P) (eme P, T rice + -ta, our). The doubling of the *t* indicates the actual local pronuciation, and represents change of weak hamzah to "*t*" before "*t*."

ende-ende (P, T), song, chant.

goele (P, T, M), savory sauce, a relish.

gondang (P) contraction of gonda (T) + dang (Pard.), negative, not to give attention.

hadepo (P), ? harepor (T), uncertain, unclear.

harangan (P, T), rough uncleared land but from karang (M, coral) and therefore probably had the original meaning of elevated coral reef or other stony rough land.

harodja (P), hordja (T), kĕrdja (M, from Sansk.), kadja (MA), work; especially community labor accompanied by ceremonies and feasting.

hijoe (P), cloth, clothing. (Cognates not found.)

hirehon (P), pahirehon (T), spread out, hung out to dry (as clothing).

hisir (P), isir (T), remove.

hoepalolo (P) from palolo (P, T), to erect a house.

hoepangindo (P (from hoe—1st person sing. + pangindo), ido, mangido T); ask, request, beg.

horing (P), horang (T), karing (M A), kĕring (M), kerah (K), dry.

imas, mangimas, diimas (P), tĕbas (M), tobas (MA), to clear second-growth forest or brush.

jordang (P) = ordang (P, T) as pronounced following *i*, planting stick with which depressions are punched in the soft ashy surface of a newly burned-over clearing for receiving the seed; mangordang (P, T), planting with these sticks.

kahon (P), houm, haum (T), kawen (M A), kawin (M), marry, wed, unite, become related. kaum (M, Arabic), relationship, family.

kode (P), kede (MA), kĕdei (M), small shop.

-koe (P), -hu (T), my, I (1st person suffix).

lagajada (P), lagiada; gariada (T), intensitive expression, used after a prohibition to indicate prohibition of the action named and everything of the sort; also means "do quite the contrary."

lahoho = laho (P), laho, lao (T), lakoe (M), go, move along.

lambar (P), lebar (M), broad, wide.

landjar (P), lantjar (M), ransar (T), quickly, soon.

mambal (P); see ambal.

mambasoe (P, MA), mĕmbasoeh (M), wash.

mamoetak (P), pentjak (M), mentjak (Jav), a sword dance or a dance without swords representing the driving away of evil persons, spirits, or influences.

mangimas (P). See imas.

mangotam (P), potong padi (M), to cut (harvest) rice.

mapir (P), morpir (T), hard; mapir djomoer, bone-dry.

marasi (P), ma + rasi (T), measure, estimate.

marbabo (P), morbabo (T), to weed the rice field.

mardahan (P), mordahan (T), to cook.

mardalan-dalan (P), mordalan-dalan (T), berdjalan-djalan (M), stroll, walk for pleasure.

markomboer-komboer (P) hombar (T), to join friends for a visit or feast.

marlangat (P), morlangat (T), to ripen.

maromboes (P), ombus, mangombus (T), ĕmbus, mengĕmboes (M), blow, blow a sudden gust.

marsada (P) to be alone; sada (T) one; sasada (T) alone.

moersakkat-sakkat (P) sangkoet (T, M), to depend upon, hang upon, make an agreement with someone.

nijordang (Pard.) ni- + ordang; niordang (T.) to be planted with rice, by using ordang (P, T), planting sticks.

nikkoe (ningkoe) (P, T), I give my word, agree, state, demand.

nikkahon (P), (ning kahon) if it be agreed.

noengnga (P), nunga (P, T), indicates completed action: non-cognate *soeda* Mal. The *ng* in this word is often written and generally pronounced twice, ending the first syllable and beginning the second.

oelang (P, K, T) imperative negative, do not stop doing.

oembe'-oembe' (P), oembe-oembe (K) guest; oembe-oembekkoe (P), my guest, hamza followed by *k* becomes *-kk-*.

pagara (P) kindle; gara (T), glowing coals.

palita (P), palito (T), pelita (M), lamp.

panoekkot (P), the cut-short house posts supporting middle of floor, from below: cf. manoktok (T), toktok, to hew wood.

paroegas (P), household goods, personal belongings, furniture; porugasan (T), owner of property.

pator (P), pator = pantar (T), girders carried by main house posts and supporting the floor of the house.

pemoelak (P), paulakhon (T) (pa- + ulak (= mulak) + -hon), return home; poelang (M).

porima (por + ima) (P), ima, paima (T), await.

ramatton (P), ramothon (T), = ramot + -hon, to guard, take care of.

reja, manareja (P), ria, mangaria (T), to invite a gathering of friends to work and then celebrate together.

robat (P), rĕbat (M), rabut? (T), roughness, obstacle, obstruction.

robo, dirobo (P T), rĕbah (M), fall, flat, topple over.

roham (P), roha (T), opinion, idea, understanding.

sakap (P, MA), tjakap (M), talk, speech.

sang (P), jang (M), which, who.

sassogot (P), sansogot (T), that work or journey which fits a morning. (? sang sogot, the sang being equivalent to Mal. jang, that which)

sirang (P), betel-nut, Areca nut. The T word sirang has the basic meaning *cut* or *separate*, but presumably means secondarily to prepare a betel quid by cutting off a bit of betel nut to chew with pepper leaf.

soewan, manoewan (P), suan, manuan (T), to plant or propagate.

takkoep (P), tangkup (T, M), agreement.

tartawa (P, MA), tĕrtawa (M), laughter.

tijoer (P), tiur (T), clear, bright.

toedija (P) = tu dia (T), where, whither, wherever.

B. WORDS FROM THE MALAY TEXT

abese (M A), Dutch, Engl. alifbata (M), alphabet.

ampir (M A), hampir (M), almost, nearly, beginning.

ana' (M A), anak (M), child.

ari (M A, T, P), hari (M), day.

badiri (M A), bĕrdiri, bĕdiri (M), stand; badiri dijatas (M A), bĕrdiri atas, stand upon.

baja' (M A), bah (M), flood.

baranti (M A), bĕrhĕnti (M), stop, stand still.

barapa (M A), bĕrapa (M), how much?

barboewah (M A), barboewa (P), bĕrboewah (M), yielding grain, in fruit.

bardjalan (M A), bĕrdjalan (M), walk, travel afoot.

barladjar (M A) = běladjar (M), learn, study.

barsilang (M A, P), formative bar + silang (P, T), sticks crossed like an ×, set up at the entrance to an enclosure where ceremonies are to be held. Their purpose is to keep out evil spirits, to warn against trespass and to notify invited guests to wait for an escort.

basar (M A), bĕsar (M), big.

bĕrsama-sama (M A), barsama-sama (M), together.

bijar (MA) biar (M), so that, in order to.

biar (M A), biar (M), so be it, to the end that.

boelih (M A), boleh (M), able, can.

boli (M A, P), mamboli (P), bĕli (M), buy.

boras (M A, P, T), baras (M A), bĕras (M), hulled uncooked rice.

dalan (M A), djalan (M), walk, go.

dangar-dangar (M A), dĕngar-dĕngar (M), listening without joining in the conversation, evesdropping.

diambel (M A) (formative di + ambel) ambil (M), take, get, make away with.

dibalakang (M A), dibĕlakang (M), behind, later.

dijatas (M A), diatas (M), above.

dini (M A) = disini (M), here.

ditobang (M A) (formative di + tobang), tĕbang (M), to fell, hew heavy timber.

ditobas (M A) (formative di + tobas), tĕbas (M), chop, clear off land.

djamoer (M A), djĕmoer (M), djomoer (T), to dry in the sun.

djattartaran (M A) = djangan tartaran (M A), no more laughing! tartawa (P), tĕrtawa (M), tĕrtawaan (M), laughter.

djimatkan (M A), djimatkĕn (M), to protect by an amulet or other magical means; djamot, ramot (T), to take great care of.

doedoe' (M A), doedoek (M), sit.

doedoengan (M A), ridge-pole. (Badings gives Jav oesoek in place of a cognate M word.)

doelang (M A), dioelang (P), (di + oelang, imperative negative), prohibit, halt.

gaggamana (M A) gagga + intensitive ima + 3rd person possessive -na, "vital energy" or "strength" of the rice, concentrated in the first rice to be cut, which is ceremoniously laid away as part of the seed for the next season. It is carried to the granary in a procession preceded by dancers. Offerings are made to it, with magico-religious ceremony. gagah (M), strength, steadfastness. gaga (Jav), the rice from the dry rice field in the mountains.

goeloeng-goeloeng (M A), gulang-gulang (T), the round timbers on which a house floor is laid. The only remotely similar M word used in carpentry, given by Badings, is *gording*, lintel (the timber above a door).

hita, kita (M A), kita (P, T), we.

hole (M A), tĕlah (M), prepared, ready.

kadja (M A), kĕrdja (M), hordja (P, T), work.

kaen (M A), ha'en (T), kajin, kain (M), cloth.

kajang (M A), kĕnjang (M), satisfied, satisfactory, full.

kalo (M A), kalau (M), when, if.

kampoeng kĕmpoeng (M A), kampong (M), village.

karas (M A), kĕras (M), hard, powerful.

karing, koring (M A), kĕring (M), dry.

kawen (M A), kawin (M), marry, marriage.

kede (M A), kĕdei (M), kode (T), shop, store.

kikita (M A), partial reduplication of kita, meaning "we together."

kipili, pili (M A), pilih (M), choose, make a selection.

ko'e (M A), kowe (M), you.

ko'epoenja (M A), your. Incorrect construction by false analogy with sajapoenja, *q.v.* (seldom used by natives except in speech with Europeans and Chinese).

koeliling (M A), ko'ĕlililing (M), keliling (Modern Indonesian *cf. Emeis* (13)), around.

la (M A), lah (M), postposition to emphasize preceding word.

lahang (M A), dahan (M), heavy branch of a tree.

lakas (M A), lĕkas (M), quickly.

larijan (M A), runway of animals; larian (M), flight, escape.

lata (M A), silliness; latah (M), hysterical condition in which women (sometimes men) imitate the actions of other persons or of animals.

lijat (M A), lihat (M), see.

lobih (M A), lebih (M), more, very.

lopas (M A), lĕpas (M), finished, free, ready.

madjar, mangadjar (M A), mĕngadjar (M), teach, instruct.

mahoe (M A), maoe (M), wish, want.

malansoeng-lansoeng (M A), mĕlantjong (Jav), stroll, wander, walk for pleasure.

malijat (M A), mĕlihat (M), see, perceive.

mamboli, (boli) (M A) (P, T) bĕli Mal., buy.

manjisip (M A), to make an offering to the spirits (e.g., a *sirih* quid) in a cleft stick; sisip, menjisip (M), to place something in between.

manjoesi, mansoesi (M A), mentjoetji (M), wash.

manoeba' (M A), mĕnoemboek (M), to stamp rice in a rice block, separating the husk from the grain.

manobas (M A), tĕbas, mĕnĕbas (M), clear off forest in preparation for agriculture.

mansoesi, manjoesi (M A), tjoetji, mentjoetji (M), to clean, wash.

mardalan-dalan (M A), berdjalan-djalan (M), walk, go, travel.

masa' (M A), masak (M), cook.

masoe' (M A), masoek (M), enter.

minta' (M A), minta (M), ask.

oerang (M A), orang (M), man, person, people.

oeloe (M A), hoeloe (M), upstream, headwaters, head.

ompat (M A), ampat, ĕmpat (M), opat (T), four.

onom (M A, T), anam, ĕnem (M), six.

padimoe (M A), padi, rice, + suffixed 2d person plural possessive -moe (= kamoe); not used in standard Malay.

parampoewan, parampoeen, (M A), pĕrampoean (M), woman.

parijoe' (M A), pĕrioek (M), pot.

parkakas (M A), pĕrkakas (M), building materials, house parts, furniture.

pedan (MA, P, T), kawan (M), friend, comrade.

pili, kipili (M A), pilih (M), choose, select.

poeran (M A), pĕrun (M), purun (T), burning felled trees, etc., in clearing land.

randang (M A), rĕndang (M), rondang (T), unthreshed rice.

rapot (M A), rapat (M), close together, crowded.

robo (M A), rĕbah (M), fell (a tree), fall down, fall upon.

roema (M A), roemah (M), house.

roen (M A), rojan (M), bad consequences, waste, destruction.

rol (M A), rel (M; supposedly Dutch *rel*), talk, report, a word used in "plantation" Malay).

sajapoenja (MA, M), "my." This construction is often condemned by the learned as utterly barbarous, and is said to be used only by Europeans or in communications with them. The ground for the criticism is that *saja* is first person singular whereas the possessive -nja is third person. It must not be forgotten, however, that the archaic meaning of saja is not really "I" but "slave" (used by inferiors to their superiors), and that sajapoenja (saja, slave, + -poen, intensitive + -nja, his) is therefore quite correct, from a historical standpoint. One could never conceivably hear akoepoennja, because akoe *really* means I.

sakali (M A), sĕkali, sakali (M), all.

sakap-sakap, sakhap, sakkap (M A), tjakap, tjakĕp (M), talk, speech.

sama sakali (M A), sama sĕkali (M), all at once.

saporti (M A), sapĕrti, sĕpĕrti (M), like, similar to.

sari (M A), tjari, tjahari (M), search, seek.

sijap (M A), siap (M), finished, done.

soesi, manjoesi (M A), tjoetji, mĕntjoetji (Mal.), wash, clean.

tamasoe' (M A); kita masoek (M), we enter.

tapi (M A), tĕtapi, tapi (M), but.

tarlantang (M A), terlantang (M), placed across a space, bridging.

tarikat (M A), tĕrikat (M), fastened, connected. The prefix tar- is used to indicate a completed condition, like the Latin past participle when used adjectively.

taroeh (M A), taroh (M), to place, put.

taroesah (M A) contraction of tĕra = tĕrada + oesah (Mal), "don't bother."

tihoes (M A, T), tikoes (M), rat.

tijang, tiang (M A), tiang (M), house posts.

timaoe (M A), tida mahoe (M), not to want.

tompat (M A), tĕmpat, tampat (M), place; tompat padi (M A), rice granary.

torang (M A), tĕrang (M), clear, bright.

toroes (M A), tĕroes (M), straight, straightway.

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HENRIK LUND, A NATIONAL POET OF GREENLAND

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IT IS the purpose of this paper to discuss both the man and his works. In describing the man, we shall refer to contemporary circumstances and conditions in his native Greenland and also to certain of his associates as will assist in a better realization of his personality.

Henrik Lund [1] was born in the village of Nanortalik, which is located at the southernmost part of the west coast, on September 29, 1875, and died June 17, 1948 at his beloved Narssaq (The Plain), not far from his birthplace. During his early years, he thus lived close to the East Greenlandic group of Eskimos, which had migrated past Cape Farewell attracted by the so called advantages of civilization. Before the colonization the East Greenlanders—declining in number—had endured hardships for a period of time.

It is not surprising therefore that he, like the other members of his family, became interested in work in East Greenland. A cousin, Johan Petersen, was a member of commander Gustav Holm's famous umiaq (skin boat) expedition to East Greenland, 1883–1885, and later became the first colony manager of East Greenland (Angmagssalik and later Scoresby Sund). Lund's mother's brother was Hansêraq (Johannes Hansen)—East Greenland's first missionary, who also partook in Gustav Holm's journey. Lund was a direct decendant, on his mother's side, of the colony manager, Anders Olsen, who founded colonies in West Greenland in the eighteenth century. In addition to this tradition of exploration and service, music and poetry played no small part in Lund's early years. There was in the vicinity a German Moravian mission, and their songs and music, which were loved by the Greenlanders, filled the Lund home. His mother was very fond of the songs in the Moravian songbook [2] of Carl Julius Spindler. There can be no doubt that Lund inherited his musical aptitude from his mother. The father, Isak Lund, who was a head-catechist (in the service of the church- and school-department in Greenland), moreover, is also known in Greenland as a poet.

In this connection it is interesting to note that Spindler, when he first came to Greenland, had lived in a time near Lund's birthplace. In 1873 Spindler moved to Neu Herrnhut at Godthaab,

FIG. 1. Henrik Lund as a pastor in Narssaq, Greenland, 1938. Photographed by Professor W. Thalbitzer.

where he taught in the Moravian seminary. He was also in charge of the mission for several years until 1888 when he returned to Germany.[3] Spindler's poems, which reflect his fascination by the beauty and grandeur of the country, brought to the Greenlanders an initial stirring of national consciousness (in this connection we could also mention the Danish poet, Knud Kjer, who about

[1] His name in full is Henning Jakob Henrik Lund. See *Atuagagdliutit* **88**(13) : 151, Nûngme (at Godthaab), July 1, 1948. The Greenlanders called him most frequently Intal'êraq (sometimes also spelled in other ways). It means Little Henrik. From the king he received the orders "Dannebrogmændenes Hæderstegn" and "Ingenio et arti"; the last mentioned is a Danish medal for artists.

[2] eríniugkat nûtigdlit 105, tamalânik imagdlit ilíniarfingme igdlunilo atortugssat (105 songs with tunes, with various contents, for the use of schools and homes), (Stolpen [in Germany] 1876).

[3] In Greenlandic, Otto Rosing has commented and edited an autobiography by Spindler: Carl Julius Spindler-ip inûnerminik oqalugtuâ (Carl Julius Spindler's account about his life), Qeqertarssuarme (at Godhavn) 1933.

half a century earlier wrote secular poems and hymns in Greenlandic). Lund was strongly influenced by the poetry of Spindler.

A few years later, Lund himself came to Godthaab, to study at the Danish Lutheran seminary. The proximity of the Lutheran and Moravian seminaries in a remote colonial community inevitably produced some blending of culture and ideas, even though these institutions had different national and religious backgrounds and were, in effect, rivals.[4] This circumstance, together with the poetry of Spindler, clearly brought a pronounced German influence into the education and cultural development of Lund.

Nevertheless, the greatest influence was Danish as might be expected. In the Lutheran seminary at Godthaab, Lund was brought into close contact with the superintendent, Nicolaj Edinger Balle.[5] Pastor Balle was a man of high moral and intellectual standard. He was a close friend of the famous Danish poet and educator, Bishop Nicolaj Severin Grundtvig, whose work played an important role in Danish cultural life. Balle himself was intensely interested in Greenland and the Greenlanders and his wife had Eskimo blood in her veins.

Another of Lund's teachers was Pastor Balle's son, Frederik Balle, who had been born and raised in Greenland. The teaching staff also included the Greenlander Rasmus Berthelsen, who was a composer of Greenlandic hymns.[6]

It is however interesting to note that even the Danish seminary utilized Moravian scholarship. The famous Moravian Samuel Kleinschmidt (the books about Kleinschmidt referred to in the footnote give this picture and discuss the reasons why he shifted over from the Moravian (Gehilfenschule in Neu-Herrnhut) to the Danish seminary nearby in Godthaab)[7]—a man of outstanding scientific capacity—had taught there for a number of years prior to his death in 1886. Kleinschmidt's knowledge of the people, through his ability and industry, markedly affected the cultural life of Greenland. Lund used his books, which had been written especially for the seminary.

The fruitful period, introduced and shaped by Samuel Kleinschmidt, was carried forward by his colleagues and successors at Godthaab in the previous century.

This circle of inspired and competent teachers and leaders was devoted to the ideal of helping and encouraging the Greenlanders to a healthy and fruitful intellectual development based essentially upon native rather than foreign background. That a so-called primitive people should be able, in a period of world-wide unrest and rapidly changing economic, social, and political conditions, to write its own literature must in large measure be credited to them.

Upon completion of his studies at the seminary, Lund was assigned to Angmagssalik, in East Greenland, as a catechist. At that time there was no direct ship connection between West Greenland and East Greenland and it was necessary to make a trip by way of Denmark. In making this journey, Lund stopped over in Denmark for about a year. During this sojourn he stayed with Pastor Christian Rasmussen,[8] who was married to the sister of Pastor N. E. Balle's wife. He also became acquainted with Professor William Thalbitzer,[9] the Eskimologist at the University of Copenhagen for many years.

In 1900 Lund finally reached Angmagssalik,

[4] The Moravians left Greenland in 1900, handing their buildings and congregations over to the Danish Lutheran church.

[5] He was the superintendent of the Danish seminary from 1870 till he died in Greenland (Godthaab), 1900. Further information appears in *Meddelelser om Grønland* 61, II: 666–667, København, 1921.

[6] Hymns composed by him can be found in the Greenlandic hymn book: tugsiutit ilagit kalâtdlit nâlagiane igdlunilo atugagssait (hymn book for the use of the Greenlandic congregations at the services and in the homes), Nûngme, 1930. This hymn book contains 446 pages in Eskimo. But besides his contribution to the hymnbook, Berthelsen has published various hymn collections. He is also known as a folkloristic collaborator to the renowned scholar and Greenland administrator Hinrik Rink. Further he was for a period the editor of the periodical *Atuagagdliutit*, which was founded by Rink and published, since 1861, in Eskimo. He was born in Greenland at Holstensborg, 1827, and died at Godthaab, 1901.

[7] Main biographies: Theodor Bechler: *Samuel Kleinschmidt, der Sprachmeister Grönlands*, Herrnhut, 1932; Otto Rosing's book in Eskimo: *Samuel Petrus Kleinschmidt inûneranik univkâq* (account of the life of Samuel Petrus Kleinschmidt), Nûngme, 1949. Samuel Kleinschmidt was an eminent scholar but had no "university" training. He is still renowned in our day. He refused an offer from the University of Berlin of a Ph.D. with the words: "So etwas braucht man in Grönland nicht."

[8] He was, as "Lektor" and consultant of the ministry (government), the actual head of the Church and School in Greenland 1904–1918. He was the father of the famous Arctic explorer, Knud Rasmussen. Further biographical data appear in *Meddelelser om Grønland* 61, II: 730–731, København, 1921.

[9] Biography by Professor L. L. Hammerich in *Dansk biografisk Leksikon* 23: 460–465, København, 1942.

where his cousin, Johan Petersen, was the colony manager. Here, for the first time, did he encounter the primitive, pagan Eskimo culture, which in this region was still fresh and relatively unchanged by outside contact. Rejecting everything which did not conform with Christian faith and ideals, nevertheless he did not condemn—as did many West Greenlanders—various harmless features of the old Eskimo intellectual culture. Strangely enough, though, the poetry of Henrik Lund is not extensively marked by the old Eskimo art of poetry. Possibly this reflects a rejection based upon some narrow-minded attitude or prejudice. However, his poetry is not entirely lacking in evidence of influence by the pagan Eskimo style. One finds, for example, an occasional use of poetic devices involving artistic systems of repetition of words, which are stylistic peculiarities typical of old Eskimo poetry.

After serving in East Greenland, Lund returned to his native West Greenland in 1909. Previously he had been recommended for ordination at the 1906 and 1907 meetings of the Lutheran pastors, but was for some time passed over as one after another of the younger clerics succeeded to a pastor's post.

Any objection to his ordination was not based on a lack of Danish university education, since many Greenlanders have been made pastors without this qualification, but on his not having the extended training in Denmark, which was customary for native pastors in Greenland. However, the experiences and contacts with great minds during his sojourn in Denmark had given him a spiritual and mental maturity, greater than he might have secured from the more formal training. In addition, his capacity and qualifications were recognized in the repeated proposals of his clerical superior that he be made a pastor. We need only to state as a fact that these proposals supported by his superior the Dean Frederik Balle remained without success.[10] Finally however his spiritual and intellectual attainments could no longer be denied. On October 9, 1936 with special solemn ceremonies and demonstrations of honor, he was ordained a pastor in the Cathedral of Our Lady in Copenhagen.[11]

Of the man himself, the following description from Thalbitzer[12] also gives us an insight into his personality:

> He has lived an active and eventful life, to be sure not without inner tensions and conflicts. He is a strong, short man, somewhat stooped, walking with short quick steps, and when he looks up, one will see a Greenlandic-Mongolic face with strong eyes of an Un-Eskimo color, bluish-grey, like luminous stones, filled with the secret dreams of the granite. . . . He is a modern pious nature-enthusiastic poet; it is hard to say whether his greatest achievements are in his musical compositions or in his poems (in oil and in water colour).

No one could meet and talk intimately with Lund, more especially in his native tongue (Eskimo), without becoming impressed with his complete love and feeling for Greenland. A man of strong character, he seemed to personify the very spirit of the land. Conscious of his Greenlandic spirit, he would not accept anything that seemed contrary to it. Deeply religious, he felt that the Greenlandic spirit was safeguarded by Christian influences.

Although desiring progress and improvement for his people, he recognized the dangers inherent in advancement through an alien culture. Christianity, to him, was the foundation of the bridge between the old and the new in Greenland.

Lund's first published poem appears in the second issue of the Greenlandic songbook *erinarssûtit*.[13] This poem *"upernalermat"* (As Spring is Coming) presumably was composed while he was living in East Greenland. We find more and more of his poems in the later issues of this publication. He soon became well known among the Greenlanders as a writer of poetry for the people, and they demonstrated their appreciation by election (supported by Danes) to the South Greenland provincial council (Sydgrønlands Landsraad), where he served from 1923 to 1932.[14]

Besides being outstanding as a writer of secular poetry, Henrik Lund has also written a number of hymns for use in the Greenlandic congregations. Many of these were included in the later Greenlandic edition of the hymn book,[15] and several

[10] Frederik Balle in: *Meddelelser om Den grønlandske Kirkesag* **64**: 13, København, 1936.

[11] *Ibid.*, 1–5.

[12] Translated from William Thalbitzer, *Inuit songs and dances from Greenland*, 11–12, København, 1939.

[13] This issue under the title: kalâtdlisut erinarssûtit (Songbook in Greenlandic), **24**, Nûngme, 1909.

[14] *Atuagagdliutit* **88**(13): 151, Nûngme, July 1, 1948.

[15] tugsiutit (hymn book), Nûngme, 1930; a few were already printed in the 1907 issue.

dozen more are found in latest issues of the hymn book supplement.[16]

The following will deal mainly with the secular poetical works of Henrik Lund attempting a classification of it. In the prose (fiction) field, he has made no contributions.

His epic poetry appears as pure epic poems and as didactic poems. As a matter of convenience poems of romance character are considered in the category of pure epic poems, even though they also belong to the domain of the lyric. Lyric poems may be classified as religious, nature and patriotic.

Lund's epic poetry does not deal with major events or deeds of the Eskimo people, but instead he limited himself to fields of apparently minor importance, which he however gave an inner value. It is strange to think that nothing would have been easier for him than to write a stirring narrative poem dealing with heroic actions of Old Eskimo culture. He, better than anybody else, could have presented the feelings, enchantments and peculiarities, which made Eskimos one of the most unusual and unique among the peoples of the world. He could have given the European influenced Greenlander a vivid picture of the characteristics, which made the Eskimo fitted to challenge the mighty forces of nature in most inhospitable latitudes. Was Lund afraid of attacks and criticism of those of his fellow countrymen, who were so eager, without hesitation and deeper reflection, to accept any kind of Europeanism, good or bad? We can only speculate.

What Lund never made public or maybe never tried to work on has so far been attempted on a minor scale by such native poets as Peter Olsen and Pavia Petersen, who respectively wrote of the glorious deeds of the legendary hero Kâgssagssuk [17] and about the strange migrations of the Eskimo people, its Odyssé.[18]

How Lund considers events in the smaller circles of the Greenland community, we learn from the song about the erection of the house of his colleague Sejer Abelsen: *"igdlugssaq nápagaungmat"* (When the House Was Built).[19] It is told that no special attention was paid, when Sâja's (i.e. Sejer's) house was built, nobody cheered. But the author asks to be listened to, when he claims that such an event cannot be ignored. Although it was bad weather, when the house was erected, it will prove to be useful. The people at Angmagssalik will show their affection amidst solitude. Why the poem was not found worthy to be reprinted in the latest (5th and 6th) issues of erinarssûtit we do not know. There are without doubt poems in erinarssûtit of lower quality than this song.

To the poems of romance character belongs the song about Narssaq (The Plain).[20]

The beautiful poem shows quite distinctly the influence of the European way of thinking together with adopted symbols and expressions from the Bible (such as the more florid oriental terms), which through European clergymen have reached Greenlandic poetry.

Lund looks from the mountain down upon his beloved Narssaq, where in his youth he met his sweetheart, who became his wife. It is to him just as beautiful as Sharon and Lebanon, it is the land of Canaan, where he, as an old man, finds anew the wonderfulness of the past. Such references to the Holy Land do not, of course, belong to complexes of ideas of the primitive Eskimo.

But the love for the homestead, the region where the Eskimo lived for the time being, is not un-Eskimo. Here we may assume that Henrik Lund was strongly influenced by his father Isak Lund.

In the father's poem, "nuna tássa tupingnartoq" (This Is a Wonderful Country),[21] we find a love for the country, which Henrik also cultivated, not at least in the song about the homestead Narssaq.

Discussing further the content of the song about Narssaq, we must maintain that a pagan Eskimo would never in his poem waste words about grass. It would not interest him at all. He would know nothing or very little about grazing cattle. Consequently, why speak about grass? But the Europeans introduced cattle in Greenland. And what else Henrik Lund sees does not occur to the mind of the pagan Eskimo: the country is fertile—Lund says, alluding to the land of Canaan, where it flows with milk and honey; he exclaims: that is why there is an abundance of milk. The pagan Eskimo would ask: "What is the fruitfulness of the meadow, what is miik of cows?" "I do not know about it," he would maintain. Neither would the pagan Eskimo be delighted by

[16] tugsiutit . . . tapê (Supplement to the hymn book), Nûngme, 1937 and 1945.

[17] In: William Thalbitzer, Inuit Songs and Dances from Greenland, København, 1939.

[18] erinarssûtit (sixth issue, Nûngme, 1946) No. 34.

[19] erinarssûtit (fourth issue, Nûngme, 1921) No. 80.

[20] erinarssûtit (sixth issue) No. 29.

[21] erinarssûtit (sixth issue) No. 7.

the pretty flowers. But leaping game, well, there he is keenly interested. Owing to the poetry of Spindler, the flowers have come into artistic consciousness of the Greenland people. The peaceful sentiment, which rests over nature in so many of Lund's beautiful poems, is not commonly found in Old Eskimo poetry either. There is, rather, unrest and motion in the animated nature of the pagan Eskimo.

Prevailing Eskimo elements we find in Lund's poem, *"motôrit nunarput sinertaleqât"* (Motorboats Are Now Sailing Off the Coast of Our Country).[22] The poem deals with a kajak letter carrier, who in trying to reach his destination used an incantation song, whereby he flew off like an angákoq, with his paddle turned backward. That was the forerunner of the motorboat, which posterity completed.

Henrik Lund produced several didactic poems, which were written for use in school. He was also a teacher himself, and his instruction—like his poetry and art—was attuned to the soul of the Greenlandic people. In other words, he gave his instruction in Greenlandic in such a way that knowledge became vital to his pupils. For this purpose, his verses were a most effective medium. He composed poems for the subjects of geography and natural history. Among the natural history poems the one dealing with the riddle of the snail is noteworthy. At the beginning of each stanza there is the anaphoric repetition: *"mêrqat ukorse, tusarnârdluse!"* (You Children, Listen Now!).[23] That fills the little ones with excitement and suspense! Among the didactic geographic poems should be mentioned the humorous: *"angalaorfigssat qaninãsanago nunap ássinga sâgkatdlauk!"* (Turn Around to the Map That You Shall Not Think You Are Too Close Your Journey's End!).[24] It is some sort of guessing game—you are getting hot.

Outside the instructive poems, which were written for the school use, the poem: "erínap nipâ" [23] (The Voice of the Tune) is to be regarded as belonging to the didactic group. The words *erínap nipâ* are repeated (symploce) in each stanza. The consequent use of patterns of repetition is typical of the style of Old Eskimo poetry, presumably the most original in the Eskimo's artistic dealing with words. The stylistic repetition manifests the emotion of the mind; it consolidates, it emphasizes, and it gives the pleasure of the realization of expectations.[25]

It is not strange that Lund also made significant contributions of lyric poetry, since he lived a rich emotional life. This is deeply expressed in his religious lyrics. First we have the spiritual songs, such as a poem like *"ilãne únulermat"* (Once at Nightfall).[26] Nature rests in a delightful and peaceful [27] harmony that corresponds and appeals so well to quiet and carefree or unoppressed minds. The beauty of nature is to Lund just a curtain in front of the spiritual, heavenly land ("silarssuavta únulersup piningârutai—anernerup nunâta umigssuâinarai"). A pantheistic basic sentiment is here hinted. We find this trait not uncommon in European Romanticism.

Of proper hymns could be mentioned *"Jîsuse pigilavkit"* (Jesus Let Me Own You) and *"Jîsuse puilassûvoq"* (Jesus is the Fountain).[28] These hymns disclose a pietistic attitude in Henrik Lund. In this respect he is quite like his teacher and superior, the late Dean Frederik Balle.

His hymns also show a desire for presenting that which is genuinely Greenlandic, in accordance with the Greenlandic soul.

The hymn of Bernhard of Clairvaux, "Hail Thee, Saviour and Redeemer," is not disliked by him. But the mountains must not express the hardness of the heart, and the ice must not symbolize its frigidity. The mountains and ice of Greenland are lovely and wonderful in their beauty. It is un-Greenlandic to compare this with something ugly or bad.[29]

The nature-lyric is for Lund a special, cultivated field; but it is also easy for him to deal with. Influence from Spindler can be traced here, as we can see in the poem *"nunat asíngagingmata"* (When the Countries Again Turned Pale).[30] It pictures the birds in their migration before the coming winter. The following translated stanzas are from Spindler and Lund.

[22] erinarssûtit (sixth issue) No. 120.
[23] erinarssûtit (sixth issue) No. 70.
[24] erinarssûtit (sixth issue) No. 116.
[25] Ulla Albeck, *Dansk Stilistik*, 112–113, København, 1939.
[26] erinarssûtit (sixth issue) No. 205.
[27] Description of peace is an important feature in the art of Lund.
[28] tugsiutit (Nûngme, 1930) No. 92 and No. 390. The first hymn to which also a tune is composed by Lund was sung by a Greenlandic choir at his ordination in the Cathedral of Our Lady in Copenhagen.
[29] Nic. E. Balle in: Meddelelser om Den grønlandske Kirkesag **64**: 11. København, 1936.
[30] erinarssûtit (sixth issue) No. 166.

Spindler: The winter covered so suddenly our country with lots of snow. All of them [the flowers] freeze, as the cold is still increasing.[31]

Lund: We will soon see the country covered with snow, dressed in the garment of the sorrow, and crying in the storm after having bidden good-bye to all the small birds.

In both poems it is told that the country is covered with snow. In the preceding line of his poem Spindler has sung about all the beautiful flowers, which now are buried. The quoted stanza relates that all of them freeze, as the cold is increasing. The snow is to Henrik Lund the garment of the sorrow. The country cries in the storm, and the passage of the dear small birds is mourned by Greenland. In both of the stanzas it is expressed that the life, which gave the country beauty and joy, now is fading away.

Although the basic thought of these two poems is the same (the coming winter), and the pictures are similar (the snow covering the ground), yet they differ in details and each has enriched Greenlandic literature. We are fully justified in saying also that Spindler's poetry belongs to the Greenlanders. His collection of poetry includes *"kalâleqatika ukorsî-â"* (You My Fellow-Greenlanders!).[32] He felt himself intimately connected with the Greenlandic people, although of European birth.

Another of Lund's many nature-lyric poems is the song *"kangerdluk tusâmassaq Ûnartoq"* (The Renowned Fiord "Ûnartoq").[33] In this Henrik Lund has broken the inhibitions which barred the way to creating an Eskimo atmosphere. Here he reveals his knowledge of Eskimo folklore so that the legendary peoples step forward full of life into the focus of our inner view. He sings about the magic fjord Ûnartoq, which owes its name to the hot spring in the vicinity, a spring which by itself is strange enough. But he enchants everyone, who is familiar with the Greenlandic, the Eskimo language, and who knows the enchanting country, where the phantasy may have an easy play and yet so full of delighting content that one reluctantly would turn from the fascinating vision. However, the prerequisite for any approach to the poem is still an understanding of the Eskimo background, an attempt, at least, to look at the picture from the Eskimo side.

[31] Translation from eríniugkat No. 83, Stolpen, 1876.
[32] eríniugkat (Stolpen 1876) No. 101.
[33] erinarssûtit (sixth issue) No. 31.

The poet says that he wondered whether he could find these strange things, which were related in the legends. But fortunately, there exists more than bare reality, the voice in his inner self being to him more real than reality itself; when he left all the scenery, which had enchanted him so much, he exclaims: thank you that I have experienced this delight of delight, this magnificent painting, Ûnartoq!

In the category of patriotic lyric Lund has composed a poem *"nunarput"* (Our Country),[34] which has become the national anthem of Greenland.

In prose translation it runs as follows:

1. Our country, when you grew very old, your head was crowned with white hair.[35] You carried steadfast your children in your arms and gave them what belonged to your coast land.

2. We who here grew up with you as an immature people, as small children, we want to call ourselves *kalâtdlit* in front of your honorable head!

3. And making use of all that belongs to you, we feel a desire to advance; bettering the conditions, which hold you back, we are firmly resolved to go forward, forward.

4. We want very much to follow the course of a mature people. We are longing to use the freedom of speech and press!

5. There is not at all the slightest reason for holding back. Greenlanders, stand up on your feet, forward! It is well worth to live as men. Show that you can think for yourselves!

A few years before this poem was written in the beginning of this century, currents of national feelings began to manifest themselves in the people. These feelings were in no small measure inspired by the Greenlandic poetry of the previous century in which such Europeans as Knud Kjer[36] and Carl Julius Spindler sang about the love for Greenland and its people.

So curiously enough we can speak about the Greenlandic national feeling as having been originally imported from Europe. As has been shown before, we find evidence in the work of Lund of influence by the poetry of Spindler. There are unmistakable resemblances in the picturing of the nature of Greenland. The love for the country shows plainly in the poems of both authors.

[34] erinarssûtit (sixth issue) No. 35.
[35] The mother's white hair symbolizes the snow on the top of the mountains.
[36] Svend Frederiksen, European influences in the poetry of Greenland, *Georgetown College Jour.* **79** (6). 7–12, Apr. 1951.

There is plenty of testimony in Lund's national anthem that European elements and pattern of thoughts have found their way into the modern Greenlandic poetry.

The parable of the mother (the country) who carries her children (the people) is not Eskimo. Nowhere in the legends or elsewhere in the original and primitive Greenland-Eskimo literature do we find the sublimated picture of the country as the beloved mother, who nourishes the people.

As the primitive people were very loosely organized, the community confined to its special circumstances, surroundings, and its domains of hunting was the constructive factor of life for the Eskimo. The world outside did not interest him very much, especially since he knew almost nothing about it.

However, in modern times affection for the homestead and tribe has grown to embrace the whole country and its people (*kalâtdlit nunât* is the term of Greenland, meaning the country of the Greenlanders).[37]

Although the song has been the object of some narrow-minded criticism by a few of the author's own compatriots it has been commonly accepted as the national anthem and stands as a fine monument of his poetry.

Lund's poems have been received by the heart and the soul of the Greenlandic people. The conglomeration of native and foreign elements in his poetry has contributed in a good sense to the progress of modern Greenland.

Lund's poems, which are all written in Eskimo, prove clearly the force of the Eskimo language in modern time. Many other native authors in Greenland have published in this language in our time; but no native poet has yet gained as much esteem by the kalâtdlit (Greenlanders) as Henrik Lund.

[37] Svend Frederiksen, *Georgetown College Jour.* **79** (6): 10–11, 1951.

THE GULF STREAM SYSTEM*

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(*Read April 25, 1952*)

ALTHOUGH the scientific history of the Gulf Stream was reviewed recently by Stommel (1950), so much field work has been carried out since then that today there is a good deal that can be added to his excellent account of the gradual evolution of our understanding of the problems presented by this most spectacular of ocean currents.

Since the pioneering study of Benjamin Franklin (1786), there have been three main observational approaches to the problems of the Gulf Stream. The first was the statistical approach and, until very recently, this was limited to surface observations. Through the leadership of Matthew Fontaine Maury, surface temperature observations and reports of surface currents experienced by navigators have been collected during the last century in ever-increasing quantities. These data were averaged by season and later by month, and also, as they increased in quantity, by smaller and smaller units of area. The most modern example of such a statistical picture of the surface characteristics of the Gulf Stream was published by Fuglister (1947). This is the sort of information shown in atlases of the ocean and is the basis of the generally accepted view that the Gulf Stream gradually broadens and weakens as it flows northeastward from Cape Hatteras toward the southern limits of the Grand Banks. As we shall see, and as was indeed pointed out by Fuglister, there are serious limitations to the statistical approach, for northeastward from Cape Hatteras the average Gulf Stream bears little resemblance to the one existing at any given time.

The second approach, which was employed vigorously during the 1930's, was to observe in cross section the distribution of temperature and salinity down to depths of 2,000 meters or more. As the theory predicted for steady state conditions, it was found that the cross current density gradient at any depth was in approximate balance with the Coriolis forces that might be expected to accompany a reasonable velocity profile. In the Straits of Florida at least, a velocity profile had been secured by direct observation and, as was shown by Wüst (1924), this agreed very well with the velocities and transport that could be computed from the observed cross current distribution of temperature and salinity under the assumptions of the Circulation Theorem. The many cross sections of the Gulf Stream off southern New England that were secured during the 1930's (Iselin, 1940) could, therefore, be interpreted with some assurance in terms of subsurface velocity and total transport, although subsurface current observations were only available from the Florida Straits. The net result of these temperature and salinity profiles was to show that the current was considerably narrower and swifter than indicated by the statistical surface charts, that it varied in transport seasonally, and perhaps over longer periods, and that major disturbances, possibly large eddies, were commonly present on either side of the current.

After World War II, when field observations could again be resumed, two new tools were available, which permitted a quite different approach. The greatly improved navigation afforded by Loran made it possible to estimate continuously the direction and velocity of the surface current being encountered by the research vessel. Thus, it was possible to maneuver in and out of the current on short tacks so as to track some features of it for considerable distances in the downstream direction. Furthermore, the development of a diving thermometer that could be used underway permitted the continuous observation of temperature down to a depth of 300 meters. The usefulness of these new techniques was first reported by Iselin and Fuglister (1948). It was soon shown that a major and hitherto unexpected feature of the Gulf Stream northeastward from Cape Hatteras was its meanders. Moreover, the current was again shown to be narrower and swifter than had been generally believed possible.

Almost simultaneously, von Arx (1950) developed a new and powerful method of observing

* Contribution No. 612 from the Woods Hole Oceanographic Institution.

surface currents from a ship underway. This depended on the electric potentials induced by the movement of the water through the earth's magnetic field.

In June 1950, it became possible to employ six ships simultaneously during a three-week period for a coordinated survey of the Gulf Stream between Cape Hatteras and the Grand Banks. All three new techniques; namely, Loran Navigation, the bathythermograph, and the geomagnetic electric kinetograph, were exploited to the utmost. Some of these results were recently reported by Fuglister and Worthington (1952), and by von Arx (in press). The six-ship survey, known as Operation Cabot, which was organized and directed by the U. S. Hydrographic Office, besides confirming the general conclusions of the previous single-ship surveys, showed that the waves forming just east of Cape Hatteras as they develop into meanders move slowly downstream and the details of the detachment of a large offshore meander south of Halifax were observed during a twelve-day period. Perhaps even more significant was the indication that two distinct Gulf Streams passed the tail of the Grand Banks.

By this time the modern students of the Gulf Stream had become thoroughly puzzled. On theoretical grounds, Stommel (1948) and Munk (1950) had been able to show that narrow swift currents were to be expected in the western part of each ocean, and Haurwitz and Panofsky (1950) were more or less able to account for the development of the meanders eastward from Cape Hatteras, but none of the available theory in any way suggested that a second warm current might develop north of the primary Gulf Stream.

In June 1951, this new feature was followed from off southern New England eastward to the Grand Banks area so that there is no longer any doubt that it is a continuous warm current, rather than a series of clockwise eddies, which one encounters along the Nova Scotian continental slope. In fact, the 1951 observations suggest that a third and similar filament of warm water develops inside this one as it crosses over to the Grand Banks. Thus, it is now thought that eastward from Cape Hatteras the warm water does not flow as a single current, but as a series of everlapping currents arranged somewhat like the shingles on a roof. In some manner, as yet by no means fully understood, the countercurrent along the inshore edge of Gulf Stream No. 1 drains off warm water and momentum, and transfers it to Gulf Stream No. 2, just to the north. Further eastward this in turn supplies Gulf Stream No. 3. Data gathered last summer by *Albatross III* east of the Grand Banks indicate that this process may continue to at least mid-ocean and possibly farther. Thus, it is indeed fortunate that of recent years we have begun to speak of the Gulf Stream System, for the old statistical Gulf Stream is not one gradually widening and weakening current, but a series of overlapping, narrow, swift streaks of flow.

The original need for the term Gulf Stream System was that on a statistical basis the Gulf Stream appeared to branch after passing the tail of the Grand Banks. Three main branches seemed to be involved (Iselin, 1936). We now see that this process has its origins well to the westward of the Grand Banks and that it is not really branching in the ordinary sense, but the development of a series of new currents, each to the north of the older ones. Much the same phenomena seem to be present in the jet streams found at high elevations in the great belts of prevailing westerly winds of mid-latitudes, although each atmospheric jet has greater dimensions than the overlapping subdivisions of the Gulf Stream System.

It must be admitted that considerable uncertainty still exists in the proper contouring of the recent temperature surveys. Proceeding at the rate of about 200 miles a day, and without any clear picture of what lies ahead, the oceanographer cannot so choose his courses on the basis of the observed temperature and surface current that there can be but one interpretation of the survey. If he follows each minor loop encountered, he cannot develop the larger picture. On moving from warm water to colder water and then back to warm water again, he does not know for certain that he is back in the same warm current. He may have found a new warm streak or an isolated eddy. To overcome this basic difficulty, it is hoped that in the near future means can be developed to observe surface temperature from a plane. At 1,500 miles a day, the interpretation of Gulf Stream temperature surveys should be much less uncertain, especially if a plane and a ship can be used together. Once the basic pattern of the Gulf Stream System has been worked out and once we know more about the rate of change of this pattern, the ship can be used again with confidence to develop details and to extend the survey into the third dimension.

Now, what can be said about the rate of change of the complicated pattern of flow making up the Gulf Stream System? Operation Cabot showed that a period of about ten days is required to pro-

duce as much change as occurs ordinarily in one day in the swift currents of the upper atmosphere. This is, of course, only one observation, but it seems reasonable in view of the huge amounts of momentum involved in ocean currents and their relative slowness compared with the winds, that changes in what might be termed "the weather map of the ocean" would be much slower than in the atmosphere. Thus, the synoptic oceanographer, when he comes into being, will perhaps have an easier or at least a more leisurely task than the weather forecaster.

To understand a phenomenon as huge and complicated as the Gulf Stream System, we must first be able to describe it accurately. Thus, for some years to come field observations must be continued and means must be developed to secure continuous data at a few critical points in the system, at least. If the past is any guide, theory will probably continue to lag behind the observational approach. However, a beginning has been made on at least one additional possible attack on the problems of the Gulf Stream. At the Woods Hole Oceanographic Institution, using funds supplied by the Office of Naval Research, a large, rotating, paraboloidal basin has been set up in the hopes of learning how to reproduce North Atlantic circulation on a model scale. In this model, which has been designed by Mr. William von Arx, the effects of the earth's rotation on currents moving through a considerable range in latitude are for the first time correctly scaled. While there are serious difficulties to be overcome, the model Gulf Stream System sufficiently resembles the prototype so that it is already clear that this new technique has great possibilities. Even if the model fails in reproducing the full complexities of the prototype, it should be extremely helpful to the theoreticians, for there is little doubt that the model can handle correctly the more simplified situations that mathematical studies can hope to formulate.

Obviously, physical oceanography still has a long way to go before oceanic circulation is thoroughly understood. Nevertheless, having recently broken away from studies of the unreal, average ocean, we can expect rapid progress to continue during the next few years.

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"THE FLOWERY FLAG DEVILS"—THE AMERICAN IMAGE IN CHINA 1840–1900

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I. INTRODUCTION

RECENT events in Asia have focused attention on the role of the western powers in that area. Western Europe and its most important supporter, the United States, are having to face the fact that the older power combinations are breaking down. Important in the recasting of roles is the fact that the Asiatic is now beginning to reassert himself and to act independently. Many of these changes and shifts have been greeted with shocked alarm and bewilderment. As the western decline becomes ever more rapid, westerners have evinced increasing discomfort that the ramparts that once seemed so secure are no longer to be trusted, and in some areas have been totally broken through by new non-western forces. Various reasons for this sudden setback have been suggested. The rise of nationalism and the influence of Russian communism have been emphasized as contributing to the recent changes.

But westerners have not, by and large, subjected their own position in Asiatic eyes to critical analysis. Too often the westerner has assumed that his own role appears to the Asiatic as it appears to him. Such an assumption is of course unwarranted. In fact it may be entirely possible that an important reason for the decline of western influence lies in the kind of conception, attitude, or image which the Asiatic has held about the West and the westerner.

It is the authors' contention that any explanation of the American experience in the years following the conclusion of World War II should take into account the images of America in China. Now these images did not begin to be formulated in the last few years, but extend back to the very birth of the Republic. It should be remembered that all images, or mental pictures, are by their oversimplification a distortion. But this does not lessen their importance. Indeed, distortions are often more important than actualities.

This study was undertaken in the belief that it would be not only of interest but of importance to make a historical study of official and unofficial efforts on the part of Americans to present to other peoples particular views and interpretations of American policies, institutions, and ideas, and of the reactions of other peoples to these efforts. The efforts were not always formal and entirely conscious, though they were often so. It is necessary to consider the implications of much that was said, written, and done. The reactions of other peoples to the presentation of American civilization differed according to class, time, and situation. The theme is obviously a difficult one; but in view of the present place of the United States in the world and the importance of intercultural relations, it is just as obviously an important one. Something has been accomplished by pioneer scholars in the study of intercultural relations, though few have approached the field in the manner here outlined.

This study makes no claims to being definitive. It is intended only to bring our researches into relation with existing knowledge and to suggest areas that may prove worthy of further research. As an interpretive monograph it is concerned largely with an analysis of the "images" that Americans tried to put before the Chinese as regards their country. Some of the Chinese reactions to these portrayals, and the resulting images the Chinese held of America, are also discussed. The material here presented is largely within the chronological period 1840 to 1900, and is from western sources.

We wish to thank Professor Earl Swisher of the University of Colorado for permission to use his unpublished doctoral dissertation, "The Management of the American Barbarians," based on Chinese sources. We are also indebted to Professor Eugene Boardman of the University of Wisconsin, who has made many helpful suggestions, saved us from errors, and given us fruitful clues.

II

The bold skipper and crew of the *Empress of China,* the first American ship to reach Canton

in 1794, made no conscious effort to impress the local hong merchants, longshoremen, and officials with any distinctive image of the country from which they came. The American merchantmen who followed seemed largely content to accept the leadership of the British in opening up the Celestial Empire to trade and to be associated with them in the minds of Chinese merchants and mandarins. But a growing trade and the prospects for an even greater commerce from the very first involved large risks for fabulous profits. American merchants and diplomatic officers in China soon began to point out the distinctive qualities of their trade and of the country in which it originated. They not only showed that American trade was second only to that of the British and that it was growing all the time; they emphasized its advantages for the Chinese as well as for the Americans.

In the 1840's American overtures found official expression in a "letter of peace and friendship" sent to the Emperor of China by John Tyler, President of the United States, and signed by his own hand. This letter announced the appointment of Caleb Cushing as minister to China and his authority to make treaties of trade. Tyler spoke in glowing terms of the greatness of both China and the United States and of his desire that they should "respect each other and act wisely." At the behest of the Department of State, American diplomatic officers stressed the idea that China's prosperity "will be to our good, and whatever leads to impair it, our loss." In this respect the Americans, declared Secretary of State Buchanan in 1845 in outlining the position our Minister was to take in dealing with the imperial authorities, would gradually lead "the Chinese to a friendly and confiding reliance upon the United States, and thus promote the commercial prosperity of your own country, while at the same time you secure benefits and blessing to China." [1]

But as the prospects for trade and profits grew and as Chinese officials become increasingly hostile to the aggressiveness of the traders and their government, Americans began to advocate different tactics. Irritated by the obstinacy of the Chinese in restricting their ports and in hampering trade at the few ports opened, some American merchants urged their government to forego diplomatic niceties, and to treat the mandarins less gently. "Discussion and reasoning with the Mandarins were exhausted long ago and it were now better to retain the sword in the right hand with an ultimatum in the left one until the Imperial Government itself seeks the latter." [2] This forceful sentiment was echoed by another merchant who said that "too much philanthropy and humanity will spoil everything. Say to them, open your ports or take the consequences." [3] On occasion American policy reflected this approach sufficient to confirm Chinese merchants and officials in their growing conviction that the Americans were quite as self-interested as the other barbarians and differed, if they differed at all, in type of verbal affirmations and, possibly, in techniques.

But despite occasional demands from the American community in China for a more positive policy and even for displays of force, the Americans continued by and large to present to the Chinese a picture of a country rapidly becoming more important in peaceful commerce, industry, and technology, closer connection with which could only be of tremendous importance and benefit to the Chinese. As the century advanced, China was urged to adopt the industrial techniques of America and to profit, as America had, by so doing. Indeed, of all the imports the westerners brought to China, their machines were to have the most far-reaching influence. In this respect America, a nation of mechanics as well as of farmers, played a prominent role. American business men and methods were to create a series of images for the Chinese. And since Americans linked their technical superiority with the progress of civilization, it was natural that in presenting images of America to China they should emphasize their machines.

In presenting the argument that China's vast population assured merchants and traders an unlimited market, interested spokesmen missed few opportunities to convince both Americans and Chinese that the exports of the United States, material and non-material, were also bound to be a great blessing to the Celestial Empire. In a pamphlet that anticipated by three quarters of a

[1] John Tyler to the Emperor of China, Washington, July 12, 1843, United States Senate Documents, 28th Congress, 2nd Session, no. 138, 8–9; Buchanan to Everett, April 15, 1845, Diplomatic Instructions, China (hereafter cited DI, with volume and page number), 1: 33–34.

[2] Nye, Gideon, Monthly Circular, June 7, 1857, Diplomatic Dispatches, China (hereafter cited as DD, with volume and date), 14 (enclosure to No. 24).

[3] Train, George Francis, *An American merchant in Europe, Asia, and Australia*, 183, N. Y., G. Putnam, 1857.

century Carl Crow's *Four Hundred Million Customers,* William E. F. Krause in 1868 discussed the American opportunity in Asia. In an extended allegory Krause envisioned a great fleet bearing the flag of freedom, visiting every cranny of the world, and teaching the blessings of God. The ships were heavily freighted with California flour for the Chinese, not to mention our manufactures. There were copies of the Declaration of Independence aboard to be widely distributed. The Bible was also on the ship in great quantities. Krause was sure it would be gratefully received by the more intelligent Chinese, "as a polite set-off on our part to their persevering efforts to add to the civilization of the civilized world by the distribution among the latter of one hundred million pounds of tea per annum; their surplus stock after nourishing three hundred and sixty million Chinese, two-fifths of all mankind." [4] In associating the Bible with the Declaration of Independence and with trade, Krause was only reflecting the already established reliance on the missionary to represent the government and to advance the national interest, chiefly the promotion of trade.

Not all business men were convinced of the wisdom of using the American missionary as a diplomat, nor did they all appreciate the energetic efforts of the churchmen to propagate the Gospel.[5] But others, such as William Robinet, Gideon Nye, and Williams, Anthou and Company, must have approved of such conduct as that of the Reverend Peter Parker as Commissioner to China. In discussing projects for the annexation of Formosa, Robinet laid great stress on the rich resources of the island, and the benefits that would thus accrue to the United States. He gave additional arguments as he pointed out that "there never was a more promising field to reward enterprise, to colonize and develop Christianity and civilization." Since it was admittedly against the policy of the United States to undertake colonial ventures outside the continental limits, it might not be desirable for the government to take measures to acquire the island. "Yet it would advance the cause of humanity, religion, and civilization if they would guaranty protection to Americans who should erect an independent government there." [6] Parker's earnest espousal of the proposition was certainly all that any enterprising trader might ask.[7]

While officials at Washington sometimes might disappoint these empire builders, the requests of the business man were not always disregarded. Indeed, in many cases leaders of the American government took the initiative in promoting American businesss interests in China. Thus private American citizens found support in a continuing campaign to introduce American technology into China. As this was introduced Chinese ideas about Americans were formed or modified.

Prior to the sending of the American mission of 1843, the Cushing mission, Secretary of State Daniel Webster, aware that our technical skill might be useful in relations with the Chinese, informed Fletcher Webster, secretary to the mission, that a fund of $1500 would be placed at his disposal. This fund was to be used for "the purchase of models of machinery, instruments of arts and sciences, or other articles such as are usually furnished from that fund, such as may be supposed most useful in intercourse with the Chinese." [8] This was a humble beginning, but American officials were unsparing in their efforts to facilitate the adoption of American techniques in China. In many of the large scale industrial or technical innovations and developments in China American diplomats played a prominent part. In order to understand how the Chinese came to regard American business and industry we need to survey the chief technological enterprises undertaken in China by Americans.

In order that trade in the treaty ports might be less subject to the treacherous reefs and the weather, American officials, in company with Europeans, pressed the Imperial Government to adopt a system of lighthouses and shore markings. Anson Burlingame, Minister to China, was pleased to announce to Secretary of State Seward that Sir Robert Hart had persuaded the Imperial Government to set aside part of the customs revenue for the purpose of erecting more adequate installations.[9] Seward, taking the hint, utilized the opportunity by having the plans of

[4] Krause, William E., *The influence of the United States abroad,* San Francisco, J. Winterburn and Co., 1868.

[5] Train, *op. cit.,* 183. See also Hayes, A. A., China and the United States, *Atlantic Monthly* **59**: 586, 590, 1887.

[6] Robinet to Parker, March 2, 1857, DD **14**, enclosure to No. 6.

[7] See the whole series of Parker dispatches in DD **14**.

[8] Daniel Webster to Fletcher Webster, April 24, 1843, DI **1**: 1.

[9] Burlingame to Seward, March 29, 1867, *Foreign Relations,* 1867, part **1**: 467.

the lighthouse system of the United States forwarded to the Imperial Government as a possible guide for future Chinese action. Chinese officials also received subsequent revisions of the American system.[10] The similarities of the American coast to China's coast made the American experience of particular value to the new developments.

To insure further the safety of American commerce, and to spread business transactions, Americans in company with other westerners took a vital interest in the development of communication facilities in China. As the Civil War drew to a close western nations, and especially America, began to draw plans for vast intercontinental telegraph lines. Secretary of State Seward instructed Burlingame to "cooperate with the Russian authorities, and those of other western powers favorably disposed toward the enterprise."[11] In 1866 the East Indies Telegraph Company was formed in Philadelphia, and at its suggestion Burlingame agreed to try to secure a concession for that company from the Imperial Government. He was to mention in one of his dispatches to Washington whether or not such a concession had been secured.[12] Seward, apparently unaware of the arrangement, relayed to Burlingame a request from the company for news with a peremptory demand for clarification. Burlingame replied that he had urged such a concession, and in a message to Prince Kung, laid stress on the speed of communication rendered by the instrument, thus insuring better government.[13] Seward agreed with the plan, and added that it might be opportune to remind the Chinese that the rival Japanese were adopting these improvements.[14]

When in 1879 the Governor of Pennsylvania, Andrew G. Curtin, became president of the Telegraph Company, further pressure was put upon the government. Secretary of State Fish responded, and in a long dispatch to William A. Howard, who had been designated as Minister, instructed him accordingly. Fish told Howard to avail himself of every opportunity to impress upon the Chinese the "practical results and the political, military, and commercial importance of the telegraphic system as practiced in your own country and in Europe." In addition the previously mentioned Morse report compiled from the displays at the Paris Exhibition of 1867 was sent to Howard to be presented to the proper authorities. The report was to be "extensively illustrated with engravings which have been made in them, and it is not doubted that the ingenuity and intelligence of the Chinese mind will find in it much to commend this great instrument of western progress and civilization to universal adoption among themselves."[15] Americans could feel gratified when the Kaiping-Tientsin line used telephones of the Bell-Edison system, and the telegraph lines were set up with the American system of the closed circuit.[16]

American diplomats not only backed their own country's enterprises in telegraphy, but those of other western powers as well. M. M. DeLano, the American consul at Foochow, played an important role in securing a telegraph concession for the Danish Great Northern Company.[17] When it seemed as if the contract to build this line might fall through, American diplomats joined other western representatives in objecting to any Chinese defection, and demanded protection for the lines that had already been built.[18]

With progress in communication went further efforts to effect western innovations in transport facilities. The slow going wooden junks, powered by wind or muscle, were soon to give way to the steamboat. Americans, seeing the lucrative profits to be made in the coasting trade, soon had a fleet of small steamers in service in the port areas. According to General James H. Wilson, the first steamboats ever used in China were built in the United States for the American house of Russell and Company.[19] Americans also controlled and owned some of the first shipyards built in Shanghai in 1864, and were prominent in the river trade on the Yangtze.[20] Thus the

[10] For the report of the action of the United States Light House Board see *Foreign Relations*, 1867, part 1: 510–512. See also Seward to Burlingame, Feb. 27, 1868, DI 2: 9 and Hunter to Low, July 18, 1871, DI 2: 142–143.

[11] Seward to Burlingame, Dec. 13, 1864, *Foreign Relations*, 1865, part 2: 424.

[12] N. Mickles to Seward, Jan. 17, 1867, *Foreign Relations*, part 1: 452. For the vast intercontinental plans of this company, see 456–458.

[13] Seward to Burlingame, Jan. 21, 1867, DI 2: 3.

[14] Seward to Burlingame, Sept. 20, 1867, DI 2: 3.

[15] Fish to Howard, May 4, 1868, DI 2: 69–73.

[16] Zuck to Young, Report on Kaiping Mines and Rails, *Foreign Relations*, 1883: 201.

[17] Seward to Davis, June 2, 1874, *Foreign Relations*, 1874: 323.

[18] Avery to Fish, Dec. 20, 1874, *Foreign Relations*, 1875, part 1: 239.

[19] Wilson, James H., *China*, 68, N. Y., D. Appleton and Co., 1901.

[20] Hinton, Richard J., A talk with Mr. Burlingame about China, *Galaxy* 66: 615–623, 1868.

Chinese were afforded a striking demonstration of the superiority of the American-invented steamboat. But of even greater importance than water transport were the new giants of the west—the railroads. Here again America combined with Europe to aid in the introduction of this transport method into China. But Americans did not forget that their experience in railroading was distinct from Europe's, nor were they averse to emphasizing their superiority over their western companions.

Perhaps the American railway system was best illustrated when Minister Charles Denby presented the Chinese with a complete model train in 1884. This model gave an excellent demonstration of our roadway and rolling stock.

> It consisted of 100 feet of main track and sidings, with switches and turntables, a passenger locomotive and sleeping cars etc. The cars were five feet long, and all other parts of the model were in equal proportion, and care had been taken to make the model throughout an exact representation in miniature of road and locomotive cars etc. in actual working in the United States, complete in the smallest detail. The motive power was clock-work.

The model was first exhibited to the friendly and powerful viceroy, Li-Hung-chang, at Tientsin. It was then taken to Peking and given to the Emperor and Empress. "It is to be hoped that this good result will be followed by measures favorable to the adoption of our system of railroads in various parts of this vast Empire." [21]

In 1887, when it began to look as if a railroad might be built from Tientsin to Taku, the American James H. Wilson of Russell and Company promptly offered a plan for its construction. Wilson proposed that the road be built with Chinese capital and be managed by the Chinese. At one time it looked as if his proposal had been accepted.[22] But the Wilson scheme seems to have been caught in an inner political quarrel, for the plan fell through. Americans, while disappointed at their failure, nevertheless looked forward to the adaptation of the American system. Denby reported that "it is admitted by railroad experts in China that the American system is best adapted to the country. It is likely that American cars will be procured for any line that is constructed. The European compartment cars are not thought as suitable as ours." [23] Although the line was finally constructed under English supervision, many American techniques were employed. The four major locomotives, while of basic British design, were altered with many American modifications. Seven double-ender tank engines and two smaller engines were furnished by the American firm of Grant and Company.

> Among the most notable adaptations of American improvements are the "bogie trucks" and the "Janney" couplers and buffers, together with a complete set of Westinghouse automatic brakes, presented by the patentees to the railroad company. The wheels and axles, which are being constructed at the company's shops at Su-Lochwang, also came chiefly from America.[24]

Denby continued his efforts in Formosa. While there on a visit he held long conferences with the Governor of the island, in which he expounded the merits of American railroads.[25] As more construction of lines meant more contracts for enterprising westerners Denby became increasingly eager to protect American interests and to insure his countrymen a just share of the ventures. In an interview with the Tsung-li Yamen, Denby stated the case for the American railroad.

Relating his countrymen's service to China, and admitting that he was not of course authorized to demand contracts, Denby pointed out that

> it was conceded by all the officials who had been consulted on railroad questions that Americans could better than any other people build great railroads; that the Government [China] had been distinctly advised on all sides to treat with Americans for building its great lines of railroads; that it had gone out all over the world that contracts would be made with Americans; that from a political point of view it was conceded on all hands that the work of developing China should be conceded to Americans, because the United States had and could have no ulterior designs on Asiatic territory; that to refuse now to grant contracts to Americans might develop bad feeling among our people at home and make them less friendly than they had always been to China.[26]

In truth the way was rapidly being paved for Willard Straight and his fellow railroad promoters.

[21] Denby to Bayard, Nov. 5, 1885, *Foreign Relations*, 1885: 181.

[22] Denby to Bayard, Feb. 25, 1887, *Foreign Relations*, 1887: 191.

[23] Denby to Bayard, June 3, 1887, *ibid.*, 219.

[24] Denby to Bayard, Oct. 23, 1888, *Foreign Relations*, 1889: 8.

[25] Denby to Bayard, July 20, 1888, *Foreign Relations*, 1888: 331.

[26] Denby to Olney, Jan. 10, 1897, *Foreign Relations*, 1897: 57.

Of almost equal concern to the westerner was the exploitation of the mineral resources of the Middle Kingdom. Precious metals had long exerted a fascination for the foreign barbarians, and by 1860 the ugly veins of coal, ore, and copper had begun to be viewed with something of the same joy which had once been exclusively reserved for gold and silver. In addition, if the new industrial techniques to be introduced into China were to be successful, these important resources needed to be developed. Americans with their technical knowledge and their aggressiveness were quick to seize upon the new mining possibilities.

Anson Burlingame sought to have the Imperial Government make a survey of its coal fields. In 1864 he finally produced the appointment of Raphael Pumpelly, a mining engineer who had had considerable experience in working for the Japanese.[27] In this period the excellent coal deposits in Saghalien were also explored, and some attempt was made by an American firm to work them. The project failed "owing to the lack of a good port at the place of shipment, of suitable machinery at the mines, and to the distance of China markets." [28]

The rapid development taking place in the Formosan mines also brought American engineers and technicians to the scene. While the machinery for the Keeling mines was English, some of the engineers were American. As early as 1877 an American expert had been sent "to report on the oil resources of the island." [29]

American technicians also took a hand in the modernization of the Kaiping mines. A school of chemistry and mineralogy was set up under the direction and supervision of Professor E. K. Buttles of Ohio, and some seven Chinese lads, formerly students in America, comprised the student body.[30] Later the Imperial Government employed an iron expert and a chemist for three years at a salary of $12,500 a year to exploit the iron mines of China.

> The announced plan is that China is to manufacture her own rails, and, having succeeded in securing material at home, she is to build railways. This employment was much coveted by the English, Germans, and French. It is undoubtedly a matter of congratulation that it has fallen to Americans, as it may be regarded as an opening wedge, an initial step, which may lead to important results.[31]

The silver mines at Jeho and the gold mines near Pingtu, in Shantung, also enlisted the services of two American mining engineers, J. A. Church and a Mr. Ellsworth. Also at Jeho was an American assayer and engineer, H. F. Dawes, and two miners fresh from the Comstock Lode of Nevada. Denby reported that "progress on the mine looks good, and everyone is encouraged." Perhaps of even greater importance was the fact that the mines were using "about 30,000 taels of pumping and hoisting machinery made in San Francisco." [32] The presentation of the importance of mining technology was associated with the image of military might which Americans emphasized.[33]

III

Any discussion of the Chinese reactions to the presentation of America as a commercial and industrial nation must first of all take into account the fact that generally speaking the Chinese did not differentiate between the westerners. All were regarded as cut of the same cloth, and thus any image of the westerner inevitably included the Americans. When a distinction was made, or when America was specifically singled out for attention, the reaction can often also be said to apply to Europeans as well. What, then, were some of the general impressions of the Chinese about the westerners as traders and industrialists?

To a very real extent the Chinese officials, particularly those versed in court etiquette, seem first to have looked upon the westerner as a barbarian tribute bearer approaching the Son of Heaven as a suppliant. This was of course in accord with the long and time honored tradition by which the outlying dependencies had paid their respect to the Emperor, and had carried on a form of trade with the Middle Kingdom.[34] Because the westerner came from great distances to bear tribute to China, it was a sign of recognition of the superiority of the Middle Kingdom. Indeed the

[27] Hinton, *op. cit.*, 622. See also *North American Review* **106**: 592–612, 1868.

[28] Seward to Fish, Feb. 9, 1876, *Foreign Relations*, 1876: 45.

[29] Seward to Evarts, June 21, 1877, *Foreign Relations*, 1877: 112.

[30] Zuck to Young, report on Kaiping mines and rails, *Foreign Relations*, 1883: 201. Herbert Hoover's connection with the Kaiping mines began in 1899. See his detailed account of mining methods in *Trans. Institution of Mining Metallurgy* **10**: 1901–1902.

[31] Denby to Bayard, Jan. 12, 1887, *Foreign Relations*, 1887: 182.

[32] Denby to Bayard, March 27, 1888 and July 9, 1888, *Foreign Relations*, 1888: 218–219.

[33] See below, p. 680.

[34] Pumpelly, Ralph, *Across America and Asia*, N. Y., Henry Holt, 1870.

length of the voyage made it an even greater sacrifice to the Son of Heaven.

As the port officials and merchants became more and more used to the westerner and as his ships came in ever increasing numbers this interpretation of the westerner began to change. Chinese merchants and officials felt that "Europeans and Americans are a gain-seeking tribe of daring adventurers; the proof of which accusation is derived chiefly from the manifest sacrifices, with respect to domestic comfort, which these foreign visitors make." [35] The original haughty, superior attitude grew into resentment and bitter astonishment as the foreigner continued to press his advantage in China. While the British may have played the leading role in forcing the Chinese hand, the Chinese were not unaware that the other westerners were quick to take advantage of any concession gained by British force.

The application of the term "fan-kuei" to all the westerners on the part of the common people of the ports suggests that they regarded the westerners with hatred and fear. Westerners became "ghosts or demons, or sprites, who restlessly wander about the earth." [36] Chinese merchants were not always treated courteously by American business representatives and the common man received even more scant consideration. The good effect of kind treatment of the coolies by many westerners was offset by occasional caning and kicking.[37] The upper classes too had some part in cultivating mass hatred of the foreigner as a means of combatting western penetration.

As the treaty settlements in the ports swelled western actions contributed to an even greater confusion in the Chinese mind. As one spectator put it, "One sells opium, another says it must not be used—one takes dollars, while the other holds the Bible." [38] Little wonder that the Imperial Government regarded all the barbarians as "by nature inscrutable." [39] As the years wore on and the barbarians continued their pressure, the Chinese became even more specific in their distaste. They could not understand what to them seemed the fanaticism and intolerance of Christianity, the use of males in queer occupations such as midwifery, the elevated status of women, the "scandalous" medical practices, the business competition, the practice of extraterritoriality, and the management of Chinese customs. All these furnished additional evidence for the Chinese suspicion that the barbarians were dangerous fellows, to be dealt with as little as possible.[40]

Perhaps the fullest exposition of the general image of the westerner was furnished the Imperial Government by the famous Tseng Kuo-Fan. Tseng wanted everyone to act towards the barbarians as befitted Confucian gentlemen. But regarding the question of barbarian penetration he pointed out that

> generally speaking, the foreigners have been devouring each other for the last few hundred years. The chief method of doing this is to take away the gain of merchants of other countries, after which their country can attain its purpose. The motive of their coming to China, establishing factories everywhere and dealing in all kinds of goods, is their desire to carry out the deceitful purpose which lies in their minds and jeopardizes the means of livelihood of our people.

Tseng concluded that if China continued to make concessions to the barbarians there would be fewer and fewer jobs for the people, and "ruin and chaos would result." [41]

This succinct evaluation of the barbarian and his imperialism may be considered illustrative of images which remained in the Chinese mind throughout the nineteenth century. Americans were included in these general images. Keeping them constantly in mind it is well to turn now to some of the different manifestations of the American image in China.

In their first contact with Americans in Macao and later at other treaty ports, the Chinese, it will be recalled, made little distinction between them and the other barbarians. Some differentiation is revealed as the Chinese identified the Americans as the Flowery Flag Devils in contrast with the British, who were called the Red-Haired Devils.[42] But as the American permanent settle-

[35] Downing, C. T., *The stranger in China* **2**: 121, Phila., Lea and Blanchard, 1838.

[36] *Ibid.*, 121.

[37] Wu Ting-fang, The causes of the unpopularity of foreigners in China, *Annals Amer. Acad.* **17**: 9, 1901.

[38] Downing, *op. cit.*, 121.

[39] Swisher, Frank Earle, The management of the American barbarians, Harvard doctoral dissertation, 1941.

[40] See the article by C. G. A., The outer barbarians from a Chinese point of view, *Once a Week* **4**: 440–445, 1861, and the article by a native literary man, What the Chinese really think of Europeans, *Fraser's Magazine* **83**: 395, 1871.

[41] The quotation is from a footnote in Hail, W. J., *Tseng Kuo-Fan and the Taiping Rebellion*, 124, New Haven, Yale, 1927, from a translation of Kawaski, *Toho-no I-jin*.

[42] Hunter, W. C., *The "Fan Kwae" at Canton before treaty days 1825–1844*, 38, Shanghai, 1938. See also the extract from Relations between the United States of

ment increased at Macao and Canton, and when the first treaty was negotiated with China in 1844, the Chinese began to be somewhat more discriminating.[43]

American policy within China brought reactions and resulting images of the devils from across the sea no less than did the customs Chinese observed in the American colonies in the port cities. To a large extent Americans in the early period in China were compared with other westerners, particularly the British. Prior to the Opium War, Chinese officials were not too unfavorably impressed with the American traders inasmuch as they went about their trading peacefully, and gave tacit assent and obedience to Chinese laws.[44] But with the negotiation of the Treaty of 1844 by Caleb Cushing, official reactions began to be revised. Chinese officials had already accepted the most favored nation treatment in the hope of conflict between the western powers. Chk'ying regarded Americans of all the barbarians as the most remote and uncivilized.[45] With the attempts of the Americans to revise the 1844 treaty along with the other powers, officials began to reveal increasing resentment. I-Liang pointed out in a memorial that

> inasmuch as the American barbarians, heretofore accounted so submissive, have taken advantage of the present conjuncture to press their demands, reliance is surely not to be placed on their cooperation though they promise it in the restoration of order. The example set by these barbarians in the propositions they have brought forward will but too probably be followed, and to a more serious extent by the English and French barbarians.[46]

When the Americans continued to press for a revision of the treaty, and became increasingly hard to handle, the memorials to the throne began to lump all the westerners together in their intentions toward China. The Chinese shrewdly realized of course the differences in ability to carry out their purposes. As such France and England were considered the most dangerous, America and Russia less so.[47] With the arrival of Burlingame in China, and the ascent to power of the more liberal court faction under Prince Kung, relations with and evaluations of the westerners took, at least superficially, a more favorable turn.[48] But with the constant encroachments upon the territorial integrity of the Middle Kingdom, and the reaction to discriminating legislation against the Chinese in America, the images reverted to earlier, more critical estimates. In these images, while America was lumped with other westerners, her position was regarded as one that might be turned to China's advantage in limiting the penetration of the alien. Since the character and sympathies of America were considered slightly different from French and British policy, China should seek first to renegotiate the unjust treaties with the United States, and then with their example and aid, turn to revising the other treaties.[49] The important point, of course, is not that America was considered as a great friend, but that she could be used more easily in the general effort to limit the westerners.

The early readiness of the Cantonese hongs to conduct limited trade with the Yankee barbarians later aroused opposition on the part of Chinese groups whose interests were thereby adversely affected. While some Americans complacently assured themselves of their good intentions in making available oil for the lamps of China, the reception of kerosene by the Chinese should have left doubts in their minds. Fire from the kerosene lamps was of course a grave danger in the densely packed urban centers. Besides it was rapidly driving the native Chinese nut-derived oil interests out of business. Proclamations were posted by local officials in an effort to dissuade buyers from taking foreign kerosene. "Kerosene is a fierce calamity" and "Kerosene means ruin" were painted on signs to be seen in the city streets. Officials imposed taxes upon the oil as it moved from the city ports into the interior, in spite of foreign protests.[50] Indeed this last named reaction of China to foreign competing goods, the imposition of the internal tax on it in transit, or the "likin," furnished occasions for endless dis-

America and China: consuls at Canton, *Chinese Repository* **5**: 220, 1836.

[43] See below.

[44] Tsiang, T. F., New light on Chinese diplomacy 1836–1849, *Jour. Mod. Hist.* **3**: 578–591, 1931.

[45] Swisher, *op. cit.*, 170.

[46] Memorial of I-Liang to Emperor on conversation with Robert McLane, June 24, 1854, DI 17, enclosure to No. 33.

[47] Swisher, *op. cit.*, 237. See also Williams to Cass, Jan. 28, 1859, DD **18**, no. 2.

[48] In this connection it is important to note the excellent article reinterpreting the Burlingame mission by Knight Biggerstaff, The official attitude toward the Burlingame mission, *Amer. Hist. Rev.* **46**: 682–701, 1936.

[49] See the memorial by Tsui Kwo Yin, Chinese minister in Washington, in *Foreign Relations*, 133, 1892. As Tsui cogently put it, "First undertake the easy and proceed thence to the difficult." See also Swisher, *op. cit.*, 387.

[50] Young to Frelinghuysen, March 28, 1884, *Foreign Relations*, 1884: 84–88.

putes between the Americans and the Chinese. The Americans, in objecting to such taxes, alienated a large section of the mandarins who counted on the tax as a source of income.

But the most important area of conflict was the introduction of railroads. While Americans along with other westerners pressed for their quick construction in China, the Chinese viewed the railways with mixed feelings. A variety of considerations explained the opposition to the railroads. Perhaps the best summing up of the whole argument was that of Li Hung-Chang in a conversation with Charles Denby. Li explained that

> the opposition comes chiefly from the censors and the board of revenue. The censors represent that numbers of men would be thrown out of employment, graves would be desecrated, and internal troubles would ensue. The board of revenue claims that if railroads are built the whole revenue service of China would have to be changed. It seems likely in effect that the likin tax, which is one of the chief sources of revenue in China, would have to be abandoned or materially modified. This is a consumation that most foreigners ardently desire. The viceroys generally oppose railroads because they tend to centralization of powers, and thereby diminish their own influence.[51]

But as the Chinese began to realize the military implications of a rail system,[52] opinion rapidly shifted. Li Hung-Chang constantly urged the government to introduce the iron horse, though with the careful provision that foreign loans would not mean foreign control. General Lin-Ming Ch'uan memorialized the throne to the effect that the railroad was necessary if China was to be a great power, able to resist the westerner.[53] The secretary to Li Hung-Chang, an American by the name of W. N. Pethick,[54] and General James H. Wilson urged the viceroy to investigate the possibility of borrowing American capital to finance the railroads.[55] Chinese who favored the railroads evinced considerable interest in the possibility of these loans, and in the general financing problems connected with large scale capital investment.[56] Once the railroad was accepted, it was natural to favor the development of coal mines by western techniques. In 1878 a Chinese company was organized to mine coal in the K'ai-p'ing basin by western methods which were accepted with certain modifications despite the occasional opposition of Chinese workers to the new labor-saving equipment.[57]

American business methods in China were not, of course, always received with favor by the Chinese. The elaborate guild systems in the urban centers often conflicted with American traders who tried to introduce their own free enterprise system.[58] Americans also attempted to break carefully established Chinese monopolies. In this they met determined opposition on the part of the Chinese officials. An American manufacturer in Shanghai, William S. Whetmore, had attempted to break a Chinese monopoly in cotton cloth manufacturing. The Imperial Government had hired American textile experts to get the industry started, and were furious at this enterprise. John Russell Young backed the American claims, on the score that the treaty gave Americans the right to manufacture in China. But Prince Kung replied in an acid retort that it did no such thing, and reminded the American Minister that the import duties in China were extremely light. "Your own Government," Kung continued, "in order to develop its manufactures, levies a heavy duty upon all imports from foreign ports, to the end that native manufactured articles may not suffer by the competition in price."[59]

Patents also irritated the Chinese. When a group of Americans bought a patent that had been granted originally by the Imperial Government to a Chinese merchant, and tried to realize on their investment, they were promptly stopped. When the Americans protested they were reminded that in China there was no law allowing a patent granted by the government to be trans-

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[51] Denby to Bayard, Nov. 5, 1885, *Foreign Relations*, 1885: 180. See also the communication between the Taotai, Feng, and the British vice consul general, Bradford, March 29, 1876, *Foreign Relations*, 1876: 51–52, for further objections to railroads. Feng particularly stressed the technological unemployment that would result from the railroads.

[52] See below, p. 680, for a discussion of military images.

[53] Memorial by Lin-Ming Ch'uan in *Foreign Relations*, 1881: 245.

[54] Pethick was a Civil War veteran who went to China in 1865 with a letter from President Lincoln, to make his fortune. He acquired skill in the language and became an authority on many aspects of Chinese conditions.

[55] Wilson, *China*, 9.

[56] Denby to Bayard, July 20, 1888, *Foreign Relations*, 1888: 331.

[57] Carlson, Ellsworth, C., The Kailan Mines 1878–1912, *Papers on China* 3, Cambridge, Harvard Regional Studies Seminars, mimeograph, 1949.

[58] For instance, see Ball, B. L., *Rambles in Eastern Asia*, Boston, J. French Co., 1865.

[59] For the Whetmore case, see *Foreign Relations*, 1883, and specifically Kung to Young, Jan. 22, 1883, 194.

ferred; in fact the holder of the patent could not transfer it without the permission of the government.[60] In a sharp note to Denby the Tsung-li Yamen requested the United States to take some form of cooperative action to prevent the importation of counterfeiting machines into China.[61]

IV

Americans in the nineteenth century rarely lost an opportunity of reminding the Chinese that America was a Christian as well as a commercial and industrial nation. The emphasis on the presentation of this image of the United States to the Chinese may be partly accounted for by remembering that in the eyes of most Americans the Chinese were pagans and heathens, and that in consequence the representatives of a Christian power felt superior. American missionaries played a large role in the creation of images of America, and it was natural that they should emphasize their own special province. All through the official dispatches of the State Department runs the constant theme of America as a Christian power. William B. Reed, Commissioner to China in 1858, constantly referred to himself as the representative of a Christian power.[62] Samuel Wells Williams, noted missionary, diplomat, and scholar in China, referred to his country as the "universal Yankee nation" and linked it with "God's plan of bringing the nations of the earth to a knowledge of His truth."[63] Thus Americans emphasized the beneficent and superior virtues of their religion to the Chinese, and talked of their country as having experienced the benefits accruing to a Christian power.

Since the missionary was first a citizen of God's Christian world he was in some respects less nationalistically inclined than his more secular countrymen. As a result American missionaries generally stressed the world Christian image, rather than a Christian American image. Indeed, men of God intent on spreading His word found that it was important not to present the Faith as an exclusively national creation. Christian universality and an attempt to utilize the Christian tradition were more often emphasized as a means of spreading the Gospel. Thus in meeting the Chinese audiences early Protestant missionaries explained that their religion did not originate in England or America, but that it was for all times and all places.[64] Missionaries eventually tried to utilize the Chinese classics to show that at one time God in His divine mercy had made known the Sabbath to the Chinese. Through an interpretation of the *Book of Changes* one preacher claimed that "it is plainly to be seen that in the time of the ancient kings, on the day of the Sabbath, all classes kept at rest and observed. It is so that the Chinese had not at first a Sabbath."[65] Later missionaries urged an even greater use of the teachings of Confucius, thus giving the Gospel a native Chinese sanction.[66]

Yet American missionaries did not by any means forget that they were Americans. They recognized that they were in a sense citizens of two worlds. God's world and their own national state both had a claim on them, and both conferred rights on them. As one missionary put it, "As God's messenger he is responsible to God alone, but as a citizen of the State he cannot disconnect himself from his fellow countrymen."[67] In this connection American missionaries could not help but represent themselves as such, and inevitably reflected images of their nation.

While there seems to be little evidence that the work of medical missionaries was a peculiarly American institution, it was often pictured as such by Americans. Ardent patriots, such as the Reverend Peter Parker, were certainly willing to claim America as the instrument of God's purpose. The medical mission served as an excellent example of the working out of a divine end. In this respect the British observers noted, a little enviously, the wisdom and success of these missions, and lauded American intentions, enterprise, and superior knowledge.[68]

In another field, however, American missionaries made a distinction between themselves and a part of the Christian world. Combining with the English Protestants, they emphasized the difference between themselves and the French Roman Catholics. To meet the ever present Chinese suspicion that the missionary was merely

[60] For further correspondence on this dispute see *Foreign Relations*, 1897.

[61] The Tsung-li Yamen to Mr. Denby, June 19, 1897, *Foreign Affairs*, 1897: 107.

[62] See Reed's dispatches to Secretary of State Lewis Cass, Department of State, China, 16 and 17, National Archives.

[63] Williams, F. W., *Samuel Wells Williams, LL.D.*, 192–193, N. Y., G. P. Putnams, 1889.

[64] *Chinese Repository* **17**: 148, 1848.

[65] *Ibid.* **18**: 158, 1849.

[66] Ross, John, Our attitude toward Confucianism. *Chinese Recorder and Missionary Journal* **18**: 1–11, 1887.

[67] See the article by the Rev. R. H. Graves, The missionary as a citizen and as an ambassador of God, *ibid.* **23**: 247, 1901.

[68] Downing, T. C., *The Stranger in China* **2**: 43, 1838.

masquerading as a religious man, while actually working as a subversive political agent, American missionaries made much of the American separation of church and state. The Reverend Gilbert Reid stressed the necessity of distinguishing between Catholic and Protestant missionaries, especially where public business was involved. Reid urged that the American Protestant acceptance of the separation of church and state be made very clear to the Chinese.[69]

In spite of such protestations American missionaries did act in official capacities for the United States. As interpreters, secretaries, and in other elevated diplomatic posts, they presented America to the Chinese. Acting in such a capacity they had to portray America as distinct from other nations.

Peter Parker, for several years the chief American diplomatic officer in China, eagerly urged that the United States present herself to the Chinese as a strong, forceful military power. Intent upon an American Empire, convinced of the benefits to be gained by the use of force, Parker applauded the firing of the Canton forts in 1857 by American naval vessels. He jubilantly and hopefully wrote, "This is the first blow that has been struck by our navy in China—and it has been done in a manner calculated to secure for it important prestige in the mind of this haughty Government." [70] In discussing suitable means of adjusting American claims, Parker again urged on Buchanan the use of naval power—America should negotiate the claims with China accompanied by "nothing short of an imposing physical force." [71] In his dispatches urging the annexation of Formosa, Parker also favored using naval power. He argued that such action would give the United States a valuable and important colonial possession, and at the same time would teach the Middle Kingdom a sharp and severe lesson. This helped to convey the idea that America was not to be trifled with, that she was the equal, if not the obvious superior, of China.[72]

When the T'ai-P'ing revolt broke out in the fifties American and British missionaries found themselves in a peculiar position. The titular head of the revolt had for a short time been a pupil of the American missionary, Issachar J. Roberts, and that worthy reverend visited the T'ai-p'ing stronghold at Nanking. Other missionaries thinking that here was the beginning of a Christian revival also supported the insurgents, and pressed for recognition of the rebels on the part of America. In this they tended to build in the Chinese a belief that the missionaries were political agents. Thus some of the missionaries, predominantly American and English, were in effect espousing a revolutionary cause which they felt was supported by Christian doctrine.[73] Therefore the American missionaries in their status of American citizens were, whether conscious of it or not, linking America with the disruption of the Manchu government by presenting Christianity as a revolutionary force.

It is true that other missionary activities did not favor such an image. Indeed, in perhaps no other field was America more graphically represented than in the non-political efforts of the missionaries to transmit western knowledge and education. One of the first American missionaries, the Reverend Elijah Coleman Bridgman, translated and published at Canton in 1838 *A Brief Geographical History of the United States of America.* This described the language, literature, religion, education, military power, and social customs of the country. The book was twice revised, in 1846 and in 1862.[74] Linguistic studies, dictionaries, and schools for learning the new language all opened avenues of communication be-

[69] Reid, Gilbert, The duty of the Christian missions to the upper classes of China, *Chinese Recorder and Missionary Journal* **19**: 465, 1888.

[70] Parker to Marcy, Nov. 22, 1856, DD **18**, no. 31.

[71] Parker to Buchanan, Feb. 13, 1857, DD **14**, unnumbered.

[72] For Marcy's withering reply to such militant and grandiose schemes see Marcy to Parker, Feb. 27, 1857, DI **1**: 152–153. That Parker as a missionary diplomat was not alone in his belief in presenting America as a strong military power is seen in the comments by Samuel Wells Williams, who championed a Society for the Diffusion of Canon Balls, to impress the Chinese with western might. See F. W. Williams, 257.

[73] The whole subject of western Christianity as a revolutionary agent because of its teaching needs thorough investigation. For instance, Parker in reporting the sermons preached in his hospital on Sunday presented Christian doctrine in such a way as certainly to lessen respect for the Chinese government. Parker pointed out that if the Emperor did not believe in Christianity, he was a sinner and would certainly go to hell. But the poorest and most humble of the Chinese, if they had faith, would enjoy eternal youth and happiness. Such a presentation was not calculated to increase profound allegiance to the Emperor, and the threat implied in the doctrine was obvious. See *Chinese Repository* **17**: 148, 1848. For an analysis of American missionary opinion and the T'ai-p'ing rebellion, see John B. Littell, Missionaries and politics in China, *Political Science Quarterly* **43**: 566–599, 1928.

[74] See Burlingame to Seward, August 23, 1862, *Foreign Relations,* 1863, part 2: 828.

tween the two nations. In this activity the missionary did yeoman service.[75]

In educational circles American missionaries again played a prominent role. Perhaps the most notable was the missionary educator William Alexander Parsons Martin, who served as a teacher and president of the Tung Wen College in 1862, and later accepted the invitation to become president of the newly formed Imperial University. Other missionaries, while not in the Imperial schools, contributed valuable services as heads of their own mission schools. In setting up such schools the missionary was faced with the question of what kind of schools they should be, and what should be taught in them.

Opinions differed on the kind of education most suitable for the Chinese. Some missionaries favored the wholesale transference of the American educational system from the grade schools and high schools to the colleges. In their minds the curricula of American schools were easily adaptable to China.[76] Others, particularly in the later decades of the nineteenth century, came to doubt the wisdom of such a plan. In the words of one missionary, the aim being to develop a Christian character, we "must prayerfully and carefully construct our own models according to the needs of the work as revealed to us here on the ground."[77] In a report of 1889 by a missionary Committee on Industrial Education, the Christian educators came out strongly for industrial education. The Committee pointed out that the Chinese were far too content with the past and with theory. Industrial education would cultivate habits of industry, a wholesome moral outlook and sounder judgment.[78]

On one thing, however, the missionaries were agreed, and that was that education for the Chinese should have a distinct and basic religious emphasis. Science, if and when taught, should be regarded as the handmaiden of religion. Technical and vocational education was to further the Lord's work. Thus in the mission schools, some of which developed into colleges and universities, the primary emphasis was on the universal character of Christianity, rather than on any particular set of national characteristics.

However, Americans of a more secular outlook were acutely conscious of the role of educational institutions in presenting their country to the Chinese. In promoting and publicizing such institutions they necessarily erected images of their nation. By 1860 relations between the Middle Kingdom and the United States had reached the stage when American diplomats began to take a real interest in the presentation of America through her schools. Although the new educational developments transcended religious education, it is logical to consider them at this point since missionaries figured in them in important ways.

With the settlement of the American claims of 1857 and 1858, and the arrival of Anson Burlingame as Minister to China, new presentations were made to the Chinese government. In November, 1860, the Reverend Samuel Wells Williams had suggested to Secretary of State Cass that the balance of the indemnity fund be used to set up an American college in China for teaching the language and literature of both nations, to students of both nations. Williams emphasized practical aspects of his proposal; it would facilitate greater ease in diplomatic exchanges. In a long dispatch to Seward, Minister Burlingame urged the adoption of the plan. Such a school would enable the Chinese to appreciate better their perilous world position and would go far toward eliminating their "pitiable ignorance of their own responsibilities." Burlingame thought it fortunate that the four major western powers were agreed on the desirability of maintaining the present Manchu dynasty, and believed that

> the American people will continue to exert an increasing influence upon this; and the establishment of a college at Peking, with a few philanthropic, well-educated, earnest-minded instructors in charge of it, would exert a lasting and excellent influence at the seat of government in support of peace and commerce throughout all the provinces. The schools which have already been established by missionaries in various places prove the feasibility of such educational efforts, and encourage the formation of a higher institution. If it promote sound morals, as well as accurate knowledge, the highest purposes of its establishment will be attained.

Burlingame, having little doubt of the efficacy of the American educational experience, recom-

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[75] For a list of these early publications see Alexander Wylie, *Memorials of Protestant missionaries to the Chinese*, Shanghai, 1867. The overwhelming number of the subjects listed are religious.

[76] McCoy, D. C., How far should the curriculum of western schools and methods of education be adapted in China? *Chinese Recorder and Missionary Journal* **14**: 249–261, 1883.

[77] Walker, E. J., The relation of education of Chinese youth in our boarding schools to the evangelization of Fuhkien Province, *ibid.* **19**: 558.

[78] *Ibid.* **20**: 49–56.

mended that this school be modeled after "the colleges of our own country." [79]

Seward agreed to place the matter before Congress, but Burlingame, impatient at the delay, followed up his original proposal with a second. In 1863 he urged that the matter be given prompt attention. The proposed institution should be named the "American College," and the American language and literature should be taught in it. The example of Britain, which had undertaken instruction in Chinese to her nationals entering the diplomatic service in China, was also a reason for action. Lastly, "if we would conserve our interest and illustrate our institutions in these regions, we must arouse ourselves from the lethargy of the slavery regime, and offer to our youth an opportunity to win those prizes in the world which belong to the good and the intelligent." Thus he proposed that students from America be selected by competitive examinations, and be paid $1,000 a year each. He felt that there should be no sectarianism in the school, but that religious exercises of some sort should be required.[80]

Though Burlingame and his successors continued to urge such a course, Congress refused to take any action.[81] However, in 1865 the Imperial Government established the Tung Wen College at Peking. Begun in 1862, it was elevated to college rank, and an American, the Reverend W. A. P. Martin, was named president. In 1877 Martin reported that the college had 101 students, most of whom were in the English school. Ten professors, four Chinese and six westerners, comprised the staff. At that time a large part of the work of the school apparently consisted of translating western works into Chinese that the school might have textbooks.[82] By 1888 the American Minister, Charles Denby, was able to report to Secretary of State Bayard that the curriculum had been considerably enlarged to include courses in chemistry, physiology, medicine, mathematics, astronomy, meteorology, physics, natural history, English, German, French, and Russian.[83]

In 1898 the Imperial University at Tientsin opened its doors, and the government offered Martin the presidency. Upon his refusal the authorities gave the post to the Reverend Charles D. Tenney. An American missionary, Tenney had become tutor to the sons of Li Hung-chang, and had several important educational posts in China. The American missionaries John C. Ferguson, W. H. Hayes, M. J. Enner, C. H. McCloy, and W. W. Peter, held important posts in the mushrooming educational institutions of the west in China. In addition to these fairly conventional schools, the Americans also urged the government to set up in China that inevitable training instrument for the armed forces, the naval-military academy. General Emery Upton prepared a plan for organizing such a school, and American Consul Sheppard backed it. But both the State Department and Chinese military authorities rebuffed these overtures.[84] All these schemes were urged on China, with the pattern of the institutions based on the American system. Thus the Chinese were impressed with the virtues and perhaps the shortcomings of American education.[85]

In addition to setting up schools and colleges in which the Chinese might learn European and American ways, westerners also had begun to transmit their learning to the Chinese through the medium of translations. In this arduous task Americans played a prominent role. While much of their effort went into the translation of the Bible and religious tracts, more and more was accomplished in secular materials as the century advanced.

In 1862 the Reverend Elijah Bridgman's history of the United States, earlier referred to, was presented by Minister Burlingame to Prince Kung and was received graciously "as a symbol of friendship." [86] By 1899 the editors of the *Chinese Recorder and Missionary Journal* proudly reviewed the two-volume effort of M. C. Wilcox, entitled *A History of the United States.* Designed for the general reader it had a glossary and table of contents in both Chinese and English.[87] More juristically inclined Americans could take pride in the fact that the translations of William

[79] Burlingame to Seward, May 19, 1862, *Foreign Relations,* 1862: 844–845.

[80] Burlingame to Seward, Nov. 18, 1863, *Foreign Relations,* 1864.

[81] *House Report No. 113,* 45th Congress, 2nd session. See also Burlingame to Seward, July 14, 1867, DD **14**, in which he stressed the "honor to the American name in this land" from such a school. Low to Fish, Sept. 7, 1871, *Foreign Relations,* 1871: 226–227.

[82] Martin to Seward, Feb. 5, 1877, *Foreign Relations,* 1877: 92–93.

[83] Denby to Bayard, Oct. 4, 1888, *Foreign Relations,* 1889: 74.

[84] Fish to Seward, Aug. 10, 1876, DI **2**: 411.

[85] Smyth, George B., American educators in China, *Outlook* **66**: 545–553, 1900. See also Rugh, A. D., America's influence in China's changing education, *University of Washington Bulletin,* Seattle, 1940.

[86] Burlingame to Seward, Aug. 23, 1862, *Foreign Relations,* 1863, part 2: 828.

[87] *Chinese Recorder and Missionary Journal* **30**: 454, 1899.

A. P. Martin and his staff included *Wheaton's International Law,* which was presented to a group of eminent Chinese officials and scholars. By 1878 another weighty tome, Woolsey's *Introduction to International Law,* was completed by the Martin group. The Protestant missionary, Alexander Wylie, in addition to printing thousands of Bibles, also translated American mathematical and astronomical writings.[88] By 1887 the American minister, John Russell Young, had succeeded in having translated under the oversight of Martin the homely sayings of Benjamin Franklin's *Poor Richard.* This took the form of a cheaply priced thirty-three-page pamphlet.[89] Charles Daniel Tenney published an English grammar and geography of Asia which, according to the editors of the *Chinese Weekly Review,* made a marked impression on a multitude of Chinese students.[90] Martin's group probably excelled all others, for the little missionary band turned out a host of books on law, social science, natural science and medicine, and philosophy,[91] not to mention the inevitable consular guides.[92]

Although it is hard to estimate the number of imprints and the kinds of material used, the sciences and technological subjects always took a high place in Chinese translations. Early in the course of relations between the two nations Congress by joint resolution, passed on the twentieth of February, 1845, presented the Chinese government with the first volumes of the Wilkes' *United States Exploring Expedition* reports. As late as 1873 Americans were still presenting the succeeding volumes of this great work to the Imperial Government. The federal government made available other technical and scientific material as the century drew toward the close. The American Minister presented to the Imperial Government Samuel F. B. Morse's report of the methods and apparatus of the European and American telegraph systems.[93] In 1871 a revised edition of the reports was presented to the Chinese government.[94] Although the American government rather than the missionaries provided these materials, the policy of making such presentations may properly be said to have been originated by the missionaries.

[88] *Ibid.* **28**: 1897.
[89] *Ibid.* **18**: 199, 1887.
[90] *China Weekly Review* **52**: 142, March 22, 1930.
[91] Smyth, *loc. cit.,* 547.
[92] Fish to William A. Howard, May 4, 1869, DI **2**: 69–73.
[93] Seward to Williams, Feb. 27, 1868, DI **2**: 9.
[94] Hunter to Low, July 18, 1871, DI **2**: 142–143.

Additional material was made available by the American D. J. Elkins who, as a member of the Martin group, translated some sixteen volumes of science primers.[95] The United States Bureau of Education noted with pride the use of translations of many American textbooks in mechanics, mathematics and science at the Kiangnan college, adjacent to the huge Kiangnan arsenal.[96] Martin in reviewing some of these activities recommended that the mission school have a small museum presenting some of the products of western culture—scientific toys, optical, electrical, and steam. These, he felt, might be used to good advantage. Martin further suggested that Chinese interest might be cultivated by providing lectures on scientific subjects as well as better texts and additional science primers. All this activity would further familiarize the Chinese with the West. Of even greater importance was the assumption that it would aid in spreading the Gospel.[97]

Martin's reasons for the erection of schools and the translations of western learning seem to have been shared by many of his countrymen. To a large extent Americans looked upon their educational system and their learning not as an end in itself, but as a useful technique in the penetration of the Middle Kingdom. Acutely conscious of the class character of educational systems in Europe, and proud of their more democratic system, Americans put forward their educational institutions as more suitable to China. In so doing many also urged China to follow the United States in erecting a universal tax-supported system of public school.[98] In the curricula of the American directed school in China the emphasis on the scientific and technical aspects of western learning illustrated an educational and social trend which in many respects was peculiarly American. Indeed, what was done in American schools in China in some respects anticipated similar achievements at home. In all this extension of American education to China missionaries were the principal

[95] Denby to Bayard, Oct. 4, 1888, *Foreign Relations,* 1889: 74.
[96] See the report, *Progress in western education in China and Siam,* Bureau of Education, Department of Interior, Washington, 1880.
[97] Martin, W. A. P., Western science as auxiliary to the spread of the Gospel, *Chinese Recorder and Missionary Journal* **28**: 111–116, 1897.
[98] McCoy, D. C., How far should the curriculum of western schools and the methods of western education be adopted in China? *Chinese Recorder and Missionary Journal* **14**: 249–260, 1883.

agents; Christianity and secular education united to form an image of the American nation.[99]

Until extensive research in local Chinese sources provides a much more considerable body of data than are now available, any generalization about the Chinese image of America as a Christian nation must be tentative indeed. Yet some things may be said with some assurance. The missionary not only penetrated deeper into the interior than the rest of his countrymen, but he came in closer contact with the Chinese people. Again, many of the Chinese images of the missionaries were not such as to identify them with a specific country. But American missionaries, while reposing their faith in the Lord, also stood on their rights as American citizens, and were not slow to call upon their government to protect, and often to extend, their rights.

In their first encounters with the Chinese, the American missionaries had to distinguish themselves from their own countrymen. What was obvious to the westerner, was not necessarily obvious to the Chinese, and men of the cloth were not considered as apart from the rest of the barbarians. Samuel Wells Williams in explaining some of the missionary difficulties to his father wrote, "our preaching is listened to by a few, laughed at by many, and disregarded by most. Our names are mixed up with the general community of foreigners, nor have they hardly begun to know us as a body of men desirous of doing good to the people." [100] However, some sort of a distinction began to be made. At first the Chinese did not differentiate between Protestants and Catholics, but they gradually came to do so as the rivalry between Protestants and Catholics was more and more apparent. [101] Such rivalry did little to enhance the status of Christianity as the Chinese spoke scornfully of its quarrelsomeness and lack of harmony in contrast with Confucianism which remained constant throughout the ages.[102]

But perhaps the greatest bone of contention between the Chinese and the missionaries arose from the demands of missionaries that native converts be not discriminated against. Such demands the Chinese finally granted in the treaty of 1858. But religious toleration often meant more than an absence of discrimination, for on occasion it resulted in withdrawing the native converts from the authority of the Chinese in secular matters. It may have been true that converts were often hauled before the local magistrates on trumped up charges, or persecuted by mobs and given little protection, and that therefore the missionary was within his rights in interfering. But the reverse may also have been the case in many instances. Native converts often joined the fold to escape justice, in spite of statements of policy to the contrary by Washington officials.[103] Missionaries continued to ask for government interference in the administration of Chinese justice. Chinese commissioners remonstrated that criminal characters and pettifoggers joined the Christian churches merely to evade the laws of the country.[104]

Other missionary activities, including the pursuit of industries reserved to the Chinese and not legally authorized by existing treaty arrangements, increased resentment.[105] A source of trouble arose when American missionaries made indentures with parents to take their children into the missions.[106] It must also be remembered that the wise men of the West were welcomed until they criticized Chinese sages and the Chinese rituals, and declared that revered ancestors were actually in hell. In writing of the missionaries a Chinese scholar observed pointedly:

> When we told them to leave they remained calling on their government to protect them, and coerced our government into protecting them. When one is killed, his life is paid for in gold, and the man who did the deed, who is really protecting his people, is executed at the prompting of the westerners. Do you wonder that we do not care to listen to the teachers from the West? [107]

Subsequent Chinese writers have made the same point. One even maintained that the intolerance of the Christian missionaries of Chinese shrines, customs, and beliefs militated against the religious

[99] See below, p. 678.

[100] Williams, F. W., *op. cit.*, 173.

[101] See report of interviews with the Chinese by the Reverend W. C. Milne in the *Chinese Repository* **13**: 14–43, 1854. See also the articles scattered through the *Chinese Recorder and Missionary Journal*, 1868–1879, volumes 1–3, particularly the article by the Rev. E. P. Thwing, China's awakening, *ibid.* **24**: 221, 1893.

[102] Tseng Kuo-Fan memorial in *Foreign Relations*, 1868, part 1: 519–526.

[103] See Davis to Low, Oct. 21, 1871, DI **2**: 151–158.

[104] See the memorial by the Imperial Commissioner at Canton in DD **24**, enclosure to No. 631. Also note the comments of Minister John Russell Young in his report to Frelinghuysen, Jan. 20, 1885, *ibid.*, 8.

[105] See Fish to Browne, May 8, 1869, DI **2**: 62.

[106] See Fish to Low, Jan. 4, 1873, DI **2**: 205 and Low to Fish, Dispatch No. 165.

[107] Bonsal, Stephen, What the Chinese think of us, *North American Review* **171**: 411–432, 1900.

tolerance which at an earlier time had permitted Buddhism to coexist with Confucianism.[108]

But perhaps the underlying basis for the ill-feeling between the missionaries and the mandarins was the latter's recognition that while Christianity as a religion was harmless, its correlative political and social aspects were bound to undermine their whole society. Try as the missionary might to convince the mandarin to the contrary, he could not be convinced that the missionary was not really a political agent, to be followed in due time by a gunboat. Again, it should be remembered that the missionary rarely had anything to do with the upper classes, the scholars, officials, and warriors, but largely concentrated his attention on the lower classes. Not only was the missionary undermining the basis of Chinese society, but in his appeal to the lower classes, he made their rulers' position less secure. Little wonder then the mandarin harbored a deep resentment against the missionary.[109] And with his conception of the missionary as a political agent, the resentment was necessarily carried over to the missionary's government, and his nation.

As the treatment of the Chinese immigrants in the United States began to be known in China, indignation against what the Chinese considered the hypocrisy of the men of God increased. Missionaries on encountering the more perceptive Chinese were coldly asked whether they had not better go home and convert their countrymen to a less murderous policy toward the Chinese in America.[110] As their bitterness flowed into riots and violence against the missionaries, the payment of claims for any damage done to missionaries and their property did not make the Chinese feel better. This was particularly the case when charges could be and were made that some missionaries were lining their own pockets by accepting payments of claims that had little basis.[111] These resentments and hatreds may have been largely confined to the upper classes. Those on the lower rungs of the social ladder were grateful for the medical attention and kind concern of the missionaries. Yet it should not be forgotten that the lower classes also participated in the anti-foreign riots, riots often directed against the missionary.

In all these images of missionaries the United States, with other western nations, was inextricably involved. There was no way in which the American separation of church and state could be made intelligible to the Chinese who were forced to bow before the church because of pressure by foreign governments. In this America was running counter to her own tradition, in spite of some efforts of the State Department to remain neutral in the whole affair. Resentment against Christian America was a constant factor in the creation of the total American image.

The Chinese image of the missionary as an ambassador of his God was associated, it will be recalled, with his educational activities. Western learning was not too welcome in the first stages of the nineteenth century. The officials wisely saw that any considerable body of western learning would expose and subvert many aspects of Chinese society. A main concern of the Chinese when negotiating the Treaty of 1844 was to limit provisions regarding teachers of Chinese and the purchase of western books.[112]

But the constant pressure of the west, pressure backed by superior military power, forced the Chinese to give way on this as they had on other points. Realizing that it was well nigh impossible to beat the westerner and his infernal war machines, more realistic Chinese officials began to urge their government to adopt western learning in order to defend China against future encroachments. In so doing the mandarins clearly recognized the close relationship between western technology and western science. In a memorial from the Chinese Foreign Office petitioning for the establishment of an institution for giving instruction in the arts and sciences of the west, the memorialists pointed out that the machines of the west clearly resulted from knowledge of the mathematical and physical sciences.[113] When

[108] Park, No Yong, *An oriental view of American civilization*, 67, New York and Boston, Hale, Cushman and Flint, 1934. See also the shrewd philosophical analysis of the impact of Christian missionaries and the reactions to them in F. C. S. Northrop, *The meeting of East and West*, N. Y., Macmillan, 1946.

[109] This is implicit in a whole series of articles and analyses by both missionaries and secular observers. See the *Chinese Recorder and Missionary Journal* **4**: 263–264, 1872; **24**: 513, 1895; and Hayllar, T. C., The Chinese view of missions, *Nineteenth Century* **38**: 769–777, 1895. For Chinese comments that substantiate this thesis see Parker, A. P., The diary of Marquis Tseng, *Chinese Recorder and Missionary Journal* **22**: 297–304, 1891, and the article of Stephen Bonsal, *loc. cit.*

[110] Hayes, A. A., China and the United States, *Atlantic Monthly* **109**: 586–590, 1887.

[111] Conway, Moncure D., Our golden-rule treaty with China, and our missionaries, *Open Court* **15**: 321–334, 1901.

[112] Swisher, *op. cit.*, 163 f.

[113] See Memorial to the Throne, DD **24**: Enclosure in Burlingame to Seward, April 10, 1867.

Martin's Tung Wen college began to make progress in translations and in the teaching of western science, Minister Seward was able to report that enlightened Chinese officials recognized that China was behind the west in arts and sciences and especially in military matters. At first the Chinese officials had thought it would be enough to purchase western machines abroad and to learn how to use them. But now, continued Seward, they see that real development can come only through the diffusion of knowledge and principles upon which the machine is based.[114] The technical and scientific emphasis of the new colleges lent even greater support to this point of view.

But while Americans and other westerners were urging their learning and educational institutions upon China, events were already transpiring which involved America and China temporarily in an unprecedented position. In 1841 a young Chinese lad named Yung Wing enrolled in the Morrison school in Macao, under the headship of the Reverend Samuel R. Brown, a Yale graduate. In 1847 Brown brought the boy back with him to America, and after some years in a preparatory academy, he entered Yale and graduated in 1854. Yung Wing returned to China, with many ideas about reforming and changing his native land, and some came to the attention of Tseng Kuo-fan. Tseng, eager to acquire some of the barbarians' military weapons, sent the young man back to America to buy machinery for making modern arms and munitions. Yung Wing bought the machinery for an arsenal from the machine shops of Fitchburg, Massachusetts, shipping it to Shanghai in 1865. There Yung persuaded the Viceroy to institute a school of mechanical engineering to be attached to the Kiangnan arsenal.[115] Later Yung in the joint service of Tseng Kuo-fan and Li Hung-Chang persuaded his superiors to memorialize the throne to set up an Educational Commission. This was finally done in 1870, when plans were made to send Chinese boys to America for training.

Li Hung-Chang soon approached the American minister, Frederick Low, to tell him of the project and to ask that a suitable reception be given to the young students. When Low inquired of Li why the Commission had chosen America as a place to train these students, Li replied that "from all the information obtained, he was satisfied that our schools possessed a superiority over those of Europe in imparting practical knowledge."[116] By the autumn of 1872 the first detachment of thirty students with Yung Wing as one of their guardians had arrived in America. The students, who were well received, took lodgings in various homes in Hartford, Connecticut. The kind treatment they received was extremely gratifying to their Chinese sponsors, and a second detachment followed the next year.[117] It was planned to send two more detachments, bringing the total to 120 students.

In 1874 Li Hung-Chang approached the American minister again, and reminding him of Article 7 of the supplementary provisions of the 1858 treaty in which both countries' nationals were to enjoy equal privileges of attending public educational institutions, asked that some Chinese students be admitted to our military academies.[118] The legation relayed the request to Secretary of State Fish, who finally notified the minister to China that one had to be a citizen of the United States to enter the academies.[119] Subsequently the decision was reversed, but apparently no student enrolled.[120] However the matter was not forgotten by the Chinese, and even after the original group returned to China, Li Hung-Chang repeated the request in 1882.[121] Minister John Russell Young merely countered with the suggestion that China set up her own military academies.[122]

But what of the students that came to America? Before they had left for the United States there was much consternation among officials lest they become entirely westernized and lose respect for their own culture. Thus several provisions were made to prevent such a thing from happening. To safeguard the

Confucian idea of loyalty to the Emperor, a staff of Chinese teachers was to accompany the mission and instruct the students in the Chinese language and Confucian classics. Specific provision was made for periodic assemblies of the students to hear the Sacred Edict read to them and to enable them to make the proper ceremonial obeisances.[123]

[114] Seward to Fish, March 13, 1877, DD **44**, no. 217.

[115] For details of Yung's activities see Yung Wing, *My life in China and America*, N. Y., Henry Holt, 1909.

[116] Low to Fish, Feb. 5, 1872, *Foreign Relations*, 1872: 131.

[117] See Low to Fish, Jan. 15, 1873, and the enclosed testimonials, *Foreign Relations*, 1873, part 1: 140–143.

[118] See Avery to Fish, Nov. 23, 1874, *Foreign Relations*, 1875, part 1: 227.

[119] Fish to Seward, June 21, 1876, DI **2**: 393.

[120] Cadwallader to Seward, Aug. 19, 1876, **2**: 419.

[121] Young to Frelinghuysen, Oct. 10, 1882, *Foreign Relations*, 1883: 126.

[122] *Ibid.*

[123] LaFargue, Thomas E., *China's first hundred*, Pullman, Washington, 1942. This excellent little book gives

The students were also warned to resist any attempt to Christianize them, and of course were required to keep their queues and to dress as befitted Chinese scholars. Such restrictions were extremely hard to enforce, and once the boys entered fully into the American environment, well nigh impossible. This factor gave the opponents of the scheme an excellent opportunity to work against the project, and by 1881 they forced the recall of the students.

American education, thus looked upon as a denationalizing influence, was suspect. These allegations were of course denied by Americans, who pointed to the conduct of some of the returned students in the naval battle off Foochow in 1884 as proof of the fact that American education made the Chinese better fitted to serve their country.[124] But little was done to resurrect the scheme. Perhaps the American exclusion acts were a compelling factor in this regard, for students did attend European schools.

It is important also to note the kind of activities in which the returned students participated. When the band first arrived back home after their sojourn in America they met with considerable hostility. However by much perseverance, and because of their technical training, they soon rose to important positions in the new developments. The overwhelming majority served the government in the new industries. In coal mining, in railroads, in the navy, in the telegraph system, in medicine, or in the newly created government colleges, these American-taught students excelled. Others went into the diplomatic service, a few became the old style mandarins, and a handful went into business for themselves.[125]

In a very real degree this handful of representatives of American education bolstered the image of America as a scientific and technological nation. This was to the Chinese the essence and value of our learning, and it would be utilized as it seemed the westerner used it—to create military power. In the nineteenth century, increasingly as the years passed, military power was reckoned in machines, the technology of the sciences. What then was the American presentation of the United States as a military power and what was the Chinese reaction to this image of the "flowery flag devils"?

V

It has been pointed out that both the official and unofficial presentation of America to China emphasized the peaceful intent of the nation's policy and the peaceful character of its civilization. Americans in fact never tired of insisting that their trade rested on a policy of peace and that the United States, in contradistinction to France and Britain, had no designs on China. It was common to remind China that the American treaties with China resulted from peaceful diplomacy rather than from force and violence.[126] In his instructions to Commissioner Alexander H. Everett, Secretary of State Buchanan told him to assure the Chinese that America has "no ambitious designs to accomplish upon them."[127] Throughout the century the Department of State pointed to the American record of peaceful negotiations with China, our non-colonial position in the world, and our refusal to resort to force. All this was impressed on the Chinese as evidence of the truth of the image.

But Americans at the same time paradoxically laid stress on their actual military power and the immense potentiality of this power in the future. Closely linked with the image of America as a commercial and industrial civilization was the picture of America as a strategic power with a geographical position putting her in a special relationship to China. In a memorial to Congress requesting a subsidy for a proposed steamship line, a San Francisco company in 1853 made the point that the United States, lying between the two great oceans of the world, would be a natural commercial arbiter of the world, if not its political arbiter. The question was whether Europe or America should control the trade of Asia.[128] After discussing the relative positions and actions of all the western powers, the memorialists concluded that the United States

> with her large interests, her whalemen and her commerce in these seas—her vast extent of coast, has comparatively no competent marine force to protect her interests, and no lines of Steamers on this side of our continent. But the time has arrived when interest and duty admit of no further delay.[129]

details of the mission, and traces some of the individual students after they returned to China in their work for the government.

[124] Young to Frelinghuysen, Dec. 12, 1884, *Foreign Relations*, 1885: 145.

[125] See La Fargue, *op. cit.*, 65 ff. for a detailed account of their service in technical capacities.

[126] See, for example, *United States Democratic Review* **42**: 352–355, 1858.

[127] Buchanan to Everett, April 15, 1845, DI **1**: 33–34. See also Caleb Jones to Peter Parker, Nov. 15, 1856, DD **13**, enclosure to No. 32.

[128] *North China Herald*, no. 196, 155, April 29, 1854.

[129] *Ibid.*

While these urgings may not have borne immediate fruit, later years saw an acceptance of this view in the colossal Pacific fleet; and while this particular memorial was addressed to Congress, Americans found opportunities to present to China a similar view of the strategic advantages and potential might of their country.

In the images presented to China progress in the art of fighting found its place. Some Americans believed that the superior western military power should never be lost sight of in dealing with the Chinese. Samuel Wells Williams looked on the Canton War of 1857 with equanimity, commenting that, "with a better knowledge of war as now carried on they will learn a thousand other things as well as the trust in foreigners as equals and friends . . . through war will surely come friendship." [130] In discoursing on a mode by which American claims on the Middle Kingdom might be settled, William B. Reed called for a blockade of some or all of the treaty ports. Reed said that such action should "be made intelligible to the Chinese, not as a mode of offensive hostility but of reprisal which even a friendly power has a right to resort to." [131]

It will be recalled that in presenting America as the great focal center of technology, diplomats, business men, and even missionaries did not hesitate to indicate the relationships between the industrial arts and military power. Western reliance on force as the final arbiter in differences with the Middle Kingdom lent real substance to the image of the Westerners as war-like devils with superior machines. In part the United States tried to disassociate itself from this image in its relations with China through its emphasis on the peaceful character of American policy and life. At the same time the Americans were not averse to letting it be known that their country was a military power of the first order. This impression was strengthened by the activities of a peculiar brand of citizens—American freebooters or professional soldiers.

Chief among this group was a small band of Americans led by a New Englander, Frederick Townsend Ward. A whole series of altercations at the treaty ports had demonstrated the superiority of western naval techniques, but it was not until the T'ai-p'ing rebellion that western land tactics were displayed on a large scale. Ward may be credited with having been the first to introduce them. In the pay of a Shanghai banking firm and under the nominal control of Li Hung-Chang, in 1860 Ward, with two fellow Americans, recruited a small force, and agreed to take certain cities for certain prices. After several failures, and altercations with western authorities, he finally developed an efficient assault force made up of American officers, Filipinos, a scattering of western deserters, and Chinese troops. Scorning the common western conception that the Chinese could not fight, Ward welded his group into an assault force that achieved astonishing success against the rebels. The force was gradually enlarged and given a high-sounding title—"the Ever-Victorious Army. Ward himself was breveted as brigadier-general. Upon his death a serious squabble ensued over the appointment of his successor. Burgevine, his junior lieutenant, was at first named. But control finally reverted to the British, who officered the force under the leadership of Gordon.[132]

The conduct of the Ward force and its role in the international political game need not detain us here. What is important is that the group demonstrated to the Chinese the superiority of western techniques and methods of fighting. More important is the fact that it definitely showed that these techniques could be easily adapted to the Chinese. Certainly our diplomats, once the Ever-Victorious Army had proven itself, wasted little time in impressing the Imperial Government with the necessity of following the example of Ward. In an interview with Prince Kung, Burlingame reminded him of the successes of Ward, and the difficulties of suppressing the rebellion. Burlingame recommended "that they should abandon the old style of fighting, and that they should organize a

[130] Williams, S. W., *op. cit.*, 248.

[131] Reed to Cass, Feb. 1, 1858, DD **16**: 17, no. 7.

[132] Much romantic nonsense has been written about Ward. See for instance Hallett Abend, *The god from the west*, N. Y., Doubleday, 1947; Holger Cahill, *A Yankee adventurer*, N. Y., Macaulay, 1930; E. Alexander Powell, *Gentlemen rovers*, N. Y., Charles Scribners, 1913; and Vincent Sheean, Admiral-General-Mandarin Frederick Ward, *Asia* **38**: 1928. Of far greater importance, though also filled with inaccuracies, are contemporary articles, such as Gerald Browne, The last months of the Taeping war, *Harpers Magazine* **32**: 594–600, 1886; A. A. Hayes, An American soldier in China, *Atlantic Monthly* **57**: 193–199, 1887, and by the same author, Another unwritten chapter of the late war, *International Review* **11**: 517–526, 1881; Edward Forrester, Personal recollections of the Tai-ping Rebellion, *Cosmopolitan* **21** and **22**, 1896, pp. 34 and 209 respectively; W. J. James, Recollections of the Chinese war of 1860, *Macmillan's Magazine* **71**: 241. By all odds the best account of Ward, though it ignores some of his activities, is that by Robert S. Rantoul, Frederick Townsend Ward, in the *Essex Institute Historical Collections* **44**, 1908.

smaller, but more efficient force against the rebellion." [133]

American citizens gave further examples of their ability in the military arts while the rebellion was in progress. In 1857, when the port city of Fuchow was being threatened by rebels, the United States consul, Caleb Jones, reported that American merchants had prepared for their own and the city's defense. In fact the Chinese officials had approached Jones to request assistance in the defense of the city.[134] Officers of the Imperial Government also approached Peter Parker to ask whether American citizens would be allowed to officer American steamers to be purchased to help put down the rebellion.[135] Perhaps the most striking display of American military organizational ability took place at Shanghai in 1862 when that city seemed about to fall to the rebels. There Edward Cunningham, the head of the American firm of Russell and Company, organized a Committee for Defense among his compatriots. The elaborate defense plan was to be permanent, with a reserve fund to maintain the installations that were to be erected.[136]

American military skill and knowledge continued to be impressed upon the Chinese after the rebellion had been put down. Precedents for the employment of American personnel were easily found. As early as 1842 an official, P'an Shih-cheng, employed the American officer J. D. Reynolds of the U.S.S. *Constellation* to experiment with depth charges, or "water thunder." The tests were made near Canton, and were apparently successful.[137] Another American engineer, Falls by name, was soon appointed superintendent of the newly created naval arsenal at Foochow.[138]

Mention has been made of the desire of American naval personnel to set up a military training school in the Celestial Empire. Further efforts to enlist the services of naval men were made when Commander James H. Gillis addressed the State Department offering his services as head of the Chinese navy, and requesting that he be recommended to the Imperial Government for that post. While Secretary of State Seward doubted the propriety of doing anything official in this matter, he told the American minister, J. Ross Browne, that he "would not object to you doing so informally if suitable occasion should arise." [139]

The American minister, Benjamin P. Avery, relayed to Li Hung-Chang, leading exponent of the adoption of western military techniques, additional naval information in the form of ordnance memoranda from the War Department.[140] As naval construction and the purchase of ships seemed near to actuality, other western powers tried to interest the Chinese in their naval prowess. French, German, and British admirals exhibited their naval might to Li Hung-Chang at Chefoo. Minister Seward, handicapped by having at hand neither a ship nor an admiral, nevertheless defended his country's navy. He told the viceroy that

> our scheme of naval organization differs from that of France and England, not because we have less enterprise or knowledge, but because our position and wants are different. As a power of great territorial extent with no distant dependencies and few occasions to anticipate war, we are content to provide thoroughly for the defense of our coasts and indisposed to expend large sums for the purchase of expensive ironclad cruising ships.

The analogy was plain to Li, and an American naval officer further impressed these views upon him.[141]

When Li Hung-Chang had completed his fleet, which consisted for the most part of the iron-clad cruising ships, American officials urged him to send the fleet to "Hampton Roads in order to show the world the great progress that China had lately made in the creation of a modern navy." [142]

These are only examples of efforts on the part of some Americans to impress upon the Chinese the military might of the United States, and the benefits to accrue to China if she adopted some of our techniques. In any effort to estimate Chinese reactions to the image of America as a military power, we are handicapped because of inability to consult Chinese sources, but data that we do

[133] Burlingame to Seward, Aug. 23, 1862, *Foreign Relations*, 1863, part 2: 828.

[134] See the dispatches of Jones to Parker, April 15, 1857, April 30, 1857, April 24, 1857, and May 5, 1857, DD **13**, enclosures to Nos. 18 and 22.

[135] Parker to Marcy, Sept. 2, 1856, DD **13**, no. 23.

[136] See *Foreign Relations*, 1862, 837, for a complete digest of the articles of the Committee.

[137] Chen, Gideon, *Liu Tse Haü, pioneer promoter of the adoption of western means of defense*, 44 ff., Peiping, 1934.

[138] Hinton, *op. cit.*

[139] Seward to Browne, March 1, 1867, DI **2**: 56.

[140] See Avery to Fish, Oct. 28, 1875, DD **33**, no. 113 and Fish to Seward, Jan. 31, 1876, DI **2**: 366.

[141] Seward to Fish, Oct. 30, 1876, *Foreign Relations*, 1877: 81.

[142] Denby to Foster, Nov. 3, 1892, *Foreign Relations*, 1892: 135.

have suggest generalizations which may be checked by later researches in China.

We have seen that Chinese officials were impressed by the organizational talents of Ward in his military venture in the T'ai-p'ing rebellion; that the Imperial Government sought admission of its future officers to West Point and Annapolis; and that industrialization made its way in part because of the persuasive American argument that it was indispensable to military power. The pacifistic professions of the United States must have suffered when, in the Canton disturbances of 1856, Captain A. H. Foote, in punishment for the death of an American sailor and insults to the flag, bombarded and destroyed the forts. But at least some Chinese regarded the bombardment not as an act of war, but as the use of police power to punish those that had fired on American ships and killed an American sailor. The refusal of President Buchanan and Secretary of State Cass to accept Minister Reed's proposal to unite with the British and French in their use of general force, convinced the Chinese officials that the starry flag devils hesitated to resort to violence.

The anti-Chinese exclusion laws in the later decades of the century provided another test of the Chinese reaction to the images the United States had presented of itself as a Christian and peaceful nation devoted to justice, and as a military power. Wu Kuang P'ei, a former member of the Chinese embassy in Washington, urged the Imperial Government to show a firm front in the negotiations and to adopt a policy of recrimination against Americans in China. America, he said, possessed only a weak military establishment and was too much concerned with her commercial and industrial development to go to war over the immigration question. "America, compared with the aggressive countries, England, France, Germany, and Russia, is like a gentle dog compared to tigers."[143] On the other hand, Yung Kiung Yen expressed a more widely held view. He condemned the American abrogation of treaty obligations and ruthless treatment of Chinese laborers as evidence that

> she has that quality which causes men to tyrannize over the weak and to fear the strong. . . . What America has to fear is not China, but the fact that she stands before the world convicted of injustice toward a weak nation, and that she puts her citizens here [in China] in a delicate and painful situation.[144]

[143] *Chinese Recorder and Missionary Journal* **20**: 565, 1889.

[144] Yung Kiung Yen, A Chinaman on our treatment of China, *Forum* **14**: 88, 1892.

The American resort to force in the Boxer rebellion dispelled any remaining doubt that the United States differed essentially from other western nations in relying on force as an instrument of national policy. Ho Yow, Imperial Chinese Consul-General in the United States, associated the Boxer fury against foreigners with the American treatment of Chinese coolies and other nationals and with the exclusion policy. Those who gloried in the anti-Chinese legislation and riots, he declared,

> may now feast their eyes on the logical sequence of their work in the ruins of Tien-Tsin, or in the blood that has washed the valley of the Pei-ho like a tide. . . . America has cut away from herself a nation which in simple justice and fairness of treatment she might mould to her own advantage.[145]

In bowing before the American use of force in the Boxer rebellion, the Chinese at last accepted the image Americans had presented of a nation of military might.

VI

It remains to consider the Chinese impressions of American social customs, political institutions, and cultural values. In presenting the United States as a Christian and peaceful nation, yet a nation of potential military might, and as a rising industrial and technological nation, Americans made little effort to present any explicit picture of their other customs and institutions. Yet those in China who came in contact with American merchants, missionaries, naval personnel, and diplomatic officers, naturally acquired impressions of American civilization. When Chinese diplomats, students, and merchants began to come to the United States, it was natural for them to form impressions of America. Without in any sense pretending to offer any systematic treatment of Chinese impressions of our civilization—much more work in Chinese sources would obviously be necessary for that—we may be justified in tentatively presenting random Chinese reactions.

The American propensity for eating and drinking while conducting negotiations or conversations

[145] Ho Yow, Chinese exclusion, benefit or harm, *North American Review* **173**: 314, 1901. For the missionary criticisms of the exclusion policy and of American attacks on Chinese coolies see *Chinese Recorder and Missionary Journal* **17**: 201–202, 1886; Rev. R. H. Graves, *Forty years in China*, 174–175, Baltimore, R. H. Woodward, 1895. For another criticism of American policy see George Francis Train, *An American merchant in Europe, Asia, and Australia*, N. Y., G. P. Putnam, 1857.

with the Chinese was exceedingly distressing to the mandarins. Toasting each other was also regarded, at best, as an odd habit.[146] American dietetic habits aroused curiosity, particularly the propensity for iced drinks which the Chinese considered injurious to the stomach.[147]

Perhaps nothing amazed the Chinese more than the status of American women. To the mandarin, reared in the patriarchal tradition, the idea that women should even be considered on a par with men was atrocious. When American and British wives began to accompany their husbands to Canton, against all regulations, the authorities evinced considerable alarm. The journeys of the "foreign devil women" through the streets of Canton often found them surrounded by a curiously hostile mob.[148] Ch'i-yung reported that "it is the worst of the barbarians to make much of their women. Whenever their visitor is a person of distinction, the wife is sure to come out to receive him." Mrs. Peter Parker had suddenly appeared during Ch'i-yung's conversations and had been introduced. The worthy mandarin remarked that he was "confounded and ill at ease, while they on the contrary were greatly delighted at the honor done them." [149] Because of the status of women, the Chinese inevitably turned their attention to the role of the family in America.

A Chinese emigrant to America in later years recounted some of the beliefs of his village near Canton. He found out that "some of the Chinese who have been here [America] twenty years and who are learned men, still believe there is no marriage in this country, that the land is infested with demons and that all the people are given over to general wickedness." [150] More extended criticisms of the family in America issued from visitors to the west. One observer noted that the Chinese marriage system was far superior to the American. Citing our elopements, clandestine marriages, and divorces as examples, they made much of American lack of reverence for parents, their neglect of ancestors. The whole family bond was considered to be far too lax. Indeed, "the American family is a grass whose seed is dispersed to the four winds and takes root wherever it finds a favoring soil." [151]

In making this criticism the author also noted several other aspects of American culture. The hallowed institution of the American newspaper met with sharp rebuke on the score of sensationalism. It was felt that the press all too often ruined the fame and good name of decent and worthy men. Too often it promoted interest in crime and worthless trash, and insulted the true scholar's love of letters. In the same vein our theater was regarded as quite objectionable. The classical dramas, it was said, were rarely played, and there was little in our lavish stage productions to be left to the imagination, while the absorption of the public in the private lives of actresses was regarded with distaste.[152] In view of these considerations it is not surprising that the Chinese should think of America as a crude and uncivilized nation.

The Chinese found American political institutions puzzling, and they were not always regarded in a favorable light. The question of the ruler of America caused considerable uneasiness. In a letter written home in 1836 Samuel Wells Williams recorded conversations with some officials. Williams reported "They could not understand how the emperor of America abdicated his throne every four years, nor why he removed his ministers so often. The business of election puzzled them exceedingly, as did also the want of an heir apparent." [153] Ch'i-yung also expressed amazement and perhaps amusement at such political goings on. He reported that the British had a female on the throne, the French a man who rules for generations, while "the chief of the American barbarians is designated by his fellow citizens and changed every four years, and as soon as an elected incumbent has finished his presidency he returns to the ranks of the people." [154]

At the same time America's democratic, equalitarian bent, with its distaste for etiquette and form, drew the attention of the mandarin. Schooled in the rigid ceremonies of an elaborate and traditional ritual, Chinese officials doubted the wisdom of such simplicity. Ch'i-yung felt, however, that

[146] See the memorial of Ch'i-ying on the character of the barbarians, captured at Canton in 1858. He had taken his notes during the negotiations with Cushing in 1855, DD **14**, enclosures No. 13.

[147] See the amusing article by Edward Bedlow, A tiffin with a Taotai, *Lippincott's Magazine* **14**: 470–477, 1891.

[148] Hunter, *op. cit.*, 74.

[149] Reed, William B., The Chinese question, *North American Review* **90**: 167, 1860. See also DD **16**, enclosure to No. 13.

[150] Holt, Hamilton, ed., *The life stories of undistinguished Americans as told by themselves*, 297, N. Y., J. Pott and Co., 1906.

[151] Martin, W. A. P., As the Chinese see us, *Forum* **10**: 684, 1891.

[152] *Ibid.*, 681 ff.

[153] Williams in a letter home, Sept. 27, 1836, in F. W. Williams, *op. cit.*, 86.

[154] Ch'i-yung memorial DD **16**, enclosure to No. 13.

it was "not possible to regulate the customs of the western states by the ceremonial of China." [155] Another official who had come in contact with the westerners made a keen distinction between them on this matter. He regarded the Americans "as more tractable and less dangerous than the British, but, on the other hand, less qualified to be presented at court because of their democratic lack of court costume, etiquette, and official insignia." [156]

A small minority of Chinese officials, however, expressed considerable admiration for republican political institutions and for democratic aspirations. In the 1870's a young student entered the college of Dr. Martin at Peking. In 1878 he came to the United States and was attached to the Chinese legation in Washington. While here he studied the work of eminent American jurists such as Kent and Story. Becoming further interested in the workings of the American political system, he visited Congress, the Supreme Court, and political conventions, and saw political personalities. After having obtained some familiarity with our political thinking he capped his efforts with a translation of the Constitution and an elaborate commentary on it.[157]

Perhaps the most favorable evaluation of America, and its founding father, George Washington, came from the scholar and official, Hsü Chi-yü, governor of Fukien province in the 1840's. Hsü Chi-yü had become much interested in western countries, and began to collect materials for a world geography. Unable to read the foreign languages, most of his data were based upon conversations with officials at Amoy. In 1848 his work entitled *A Sketch of the Wide World* was published in ten volumes.[158] While full of errors, it was important in that it tried to show that the westerner was not as bad as hitherto conceived. For Americans the work was of particular interest as it contained a long eulogy of George Washington.

Hsü Chi-yü's simple story of Washington was filled with admiration for his self-restraint on his own power in refusing to become king or emperor. Washington was compared in bravery and daring with Chinese heroes, while his refusal to glorify or exalt the soldier or the military arts revealed a "principle totally unlike what is found in other kingdoms. Ah, who is there who would not call him a hero?" [159] Perhaps most important were the institutions that the great man cherished. In regard to the elective process Hsü Chi-yü asked, "Where in the world can be found a mode more equitable?" Upon the solid foundations of the republic had arisen a strong and prosperous nation. Trade had increased rapidly, and the rest of the nations dared not encroach upon the United States. Within this great country there was peace, stability, and harmony between the states. Truly here was an example to be carefully considered.

But Hsü Chi-yü was far in advance of his time, for his predilections for the western barbarian soon brought him into disfavor and he was dismissed from his post in 1851. His dismissal is probably more significant than his own avowals and opinions. However such was not always to be the case, and in 1865 he was appointed to the Foreign Office, and later given the presidency of Tung Wen College. Upon hearing of his new assignment, Samuel Wells Williams promptly called on him, and was greeted with the question, "Are you a countryman of Washington?" This was followed by inquiries about the United States. When Williams informed Secretary of State Seward about Hsü Chi-yü, Seward responded by having an artist copy one of Stuart's paintings of Washington, and suitably framed, the portrait was sent to the mandarin.

At the impressive presentation ceremony both the Americans and the Chinese utilized the occasion to exchange compliments and hopes for the future. The Americans recited Hsü Chi-yü's achievements and his appreciation of America and discoursed on the reciprocal affection of Americans for certain aspects of Chinese society. Then the speaker launched into an earnest plea for the adoption by the Chinese of American techniques and industry. In a graceful acceptance speech, Hsü Chi-yü dwelt at length on Washington's sterling character, and concluded that the hero's "merit makes him a perfect link to connect the great men of antiquity with those who will come in all time, so that his name will surely be honored by mankind through all cycles." [160]

Such graceful plaudits of America were, however, seemingly few. By 1890, after the passage of the exclusion acts, more critical appraisals were

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[155] *Ibid.*

[156] Swisher, *op. cit.*, 231.

[157] *Nation* **34**: 29, 1882.

[158] This book was later to influence Liang Ch'i-ch'ao, a part of the reform faction grouped around K'ang yu-wei.

[159] Extract from the *General geography of the United States*, enclosure in dispatch from Burlingame to Seward, Peking, Feb. 9, 1867, DD **13**.

[160] The story of this official, and the incidents related, may be found in the series of dispatches and their enclosures, Williams to Seward DD **12**, **23**, **24**.

made of the American system. The Marquis Tseng, son of the famous Tseng Kuo-Fan, and a believer in the westernization of China, was far more critical. Tseng pointed out that America is "nominally a Democracy, but in every election immense sums of money are spent in bribery, the country is ruled by parties, and an election simply results in exchanging one party for another. How can there be good government under such conditions as these?" [161] Other officials noted the lack of trained government personnel, the excess of spoilsmen, the noisy, bombastic strife of electioneering. When some zealous Americans asked Yung Wing, a minor scholar and diplomat, to assist in a constitutional convention to promote republican government in China, his reply was withering.

> In view of what the United States has done, for the past twenty years in the way of enacting obnoxious laws against the Chinese, and without any provocation, flinging insult after insult in the very teeth of the Chinese Government, I cannot for the life of me see how republicanism is to become universal, or how the torch of American liberty is to enlighten the eastern races when they are shut out from its light.[162]

Evidently the seeds of American government and politics would not sprout quite as easily as some Americans had assumed.

It is clear that Chinese respect for American political institutions and democratic professions diminished to a vanishing point when the federal government insisted, in the 1870's and 1880's, that it was powerless to punish the anti-Chinese rioters on the Pacific coast and in the mountain states. Officials of the Celestial Empire were quick to point out that it was the federal government, not California, Wyoming, and Colorado, that took the initiative in negotiating treaties promising fair treatment of the nationals of each country resident in the domain of the other. Nor did the Chinese government spare irony in calling attention to the inconsistency of the Americans in demanding that the central authorities in China punish local officials for failure to protect Americans while they insisted in the United States that federal authority could not intervene with state officials in comparable situations.[163]

Chinese officials were even more bitter when the federal government, ignoring treaty obligations, enacted the Chinese exclusion laws. Spokesmen for the Peking government pointed out that agents of the Pacific railway had appeared in China to persuade Chinese workers to migrate to America; that these workers had crossed the Pacific to make money, just as immigrants from Europe had done; and that the Chinese workers had contributed substantially to the economic development of the United States; and that the arguments brought against them on the ground of their threat to the American way of life were identical with those earlier mustered against Irish immigrants.[164] Yan Phou Lee voiced a view commonly held in official circles in writing that the American Republic had departed from its high ideal of the equality of men in singling out the Chinese for restrictive treatment.[165]

Chinese pride, of course, suffered a cruel blow. "We condemn the Exclusion Bill altogether," wrote Yung Kiung Yen, "because it singles us out for exclusion and thereby degrades us, not only before the world, but before all other Asiatics. . . . If we feel aggrieved at the American people's hostility, we feel indignant at their leaders for the *manner* of showing this hostility." [166] Prime Minister Li Hung-Chang told one American he had better return to his own country to convert his own people to a more just treatment of the Chinese, rather than to continue in his efforts to convert the Chinese to Christianity.[167] In the eyes of China, declared the Imperial Consul-General, the exclusion laws "have thrown the western world into an attitude of non-intercourse and unfriendliness." [168] It is impossible to say to what extent the official resentment of the exclusion policy permeated the general Chinese population. There were but three Chinese newspapers in the early 1890's; and while these strongly denounced American policy, their readers, of course, were limited.[169] But it is clear that the Boxers were aware both of

[161] Parker, A. P., The diary of Marquis Tseng, *Chinese Recorder and Missionary Journal* **22**: 300, 1891.

[162] Martin, W. A. P., As the Chinese see us, *Forum* **10**: 688, 1891.

[163] Chen Han Pin to Secretary of State Evarts, Washington, Nov. 10, 1880, in *Foreign Relations*, 1881: 318; Evarts to Chen Han Pin, Dec. 30, 1880, *ibid.*, Chen Han Pin to Evarts, Jan. 21, 1881, *ibid.*, 332–333; Chen Han Pin to Evarts, Feb. 25, 1881, *ibid.*, 335–337.

[164] Wu Ting-Fang, Mutual helpfulness between China and the United States, *North American Review* **171**: 1–22, 1900.

[165] Yan Phou Lee, The Chinese must stay, *North American Review* **148**: 476–483, 1889.

[166] Yung Kiung Yen, A Chinaman on our treatment of China, *Forum* **14**: 87, 1892.

[167] China's view of Chinese exclusion, *Forum* **14**: 407, 1893.

[168] Ho Yow, Chinese Exclusion, a benefit or a harm, *North American Review* **173**: 314, 1901.

[169] Yung Kiung Yen, *loc. cit.*, 87.

the mistreatment of Chinese in America and of the exclusion policy of the United States Government.

The Boxer outbreak at the end of the century did not come out of a blue sky. As early as 1875 the American legation in its dispatches to Washington referred to Chinese pictures showing foreigners plucking out the eyes and hearts of Chinese children, and depicting massacres of western barbarians.[170] Although Li Hung-Chang complied with the request of American officials that the pictures be destroyed, others took their place. Throughout the 1880's and 1890's sporadic outbreaks against westerners in places as widely separated as Canton and Chungking seemed to be connected with pamphlets and placards denouncing Christianity as worship of "the hog ancestor Jesus" and as given to debauchery, occult human sacrifices, and debauched magic. The placards and pictures charged westerners with kidnapping children, bewitching adults to get their eyes and brains, and indulging in all sorts of unspeakable crimes.[171] These anti-foreign writings and pictures, together with the occasional riots, paved the way for the dreadful outbreak under the auspices of the Boxers in which little if any distinction was made between Americans and other westerners.

The ill-feeling reflected on the one hand by the slaughter of Chinese in the United States and by the exclusion policy, and on the other by the growing evidences of overt anti-foreign feeling in China, reflected a half-century of Chinese American relations far different from that first fully outlined so hopefully by Secretary of State Daniel Webster in 1843. Webster told our first envoy, Caleb Cushing, to remind the Chinese that "the Government of the United States is always controlled by a sense of religion and of honor." Cushing's

> constant aim must be to produce a full conviction on the minds of the Government and the people that your mission is entirely pacific; that you come with no purposes of hostility or annoyance; that you are a messenger of peace, sent from the greatest power in America to the greatest Empire in Asia to offer respect and good will, and to establish means of friendly intercourse.

Webster further admonished Cushing not to interfere in any quarrels between China and European powers, and at the same time to pursue a policy that would give no cause for European offense.

He then concluded his instructions with a classic paragraph embodying a whole series of images to be presented to the Chinese.

> You should in a proper manner, always keep before the eyes of the Chinese the high character, importance, and power of the United States. You may speak of the extent of their territory, their great commerce spread over all areas, their powerful navy, everywhere giving protection to that commerce, and the numerous schools and institutions established in them to teach men knowledge and wisdom. It cannot be wrong for you to make known, where not known, that the United States, once a country subject to England, threw off that subjection years ago, asserted its independence, after a seven years' war, and now meets England upon equal terms upon the ocean and upon the land.[172]

Although this last point—the dissimilarity of the United States with the rest of the westerners—was never lost sight of in the following years, in the end the Chinese regarded the flowery flag devils pretty much as they did the other outer barbarians.

The images of the United States that Webster wanted to have presented to China—the Christian and honorably peacelike character of the nation, its extensive commerce and rising industry, its learning, its potential power, and the distinctive qualities that differentiated it from Europe—were consistently set forth again and again. As Americans reached the western coasts of the United States, and as the continental area became more and more stabilized, their interest in China mounted, and the imagery became more colorful and intense. But while the Chinese at times and in certain situations tended to accept, with qualifications, some of the images of America thus presented, they never did so in any full and thorough way. From the 1870's to the end of the century, when the anti-Chinese riots in the United States and the exclusion policy contradicted many of the images of the American civilization that merchants, missionaries, and diplomats had been presenting to China, the Chinese were more skeptical than

[170] Avery to Fish, June 22, 1875, *Foreign Relations*, 1875, part 1: 345–347.

[171] Denby to Bayard, July 31, 1886, *Foreign Relations*, 1887: 159; Lewis to Hykes, July 7, 1886, *ibid.*, 160; Denby to Blaine, Jan. 30, 1892, *Foreign Relations*, 1892: 85; Denby to Blaine, March 5, 1892, *ibid.*, 90; Denby to Wharton, July 27, 1892, *ibid.*, Denby to Blaine, March 14, 1892, *ibid.*, 92; Denby to the Tsung-li Yamen, July 9, 1895, *Foreign Relations*, 1895: 94–95.

[172] Webster to Cushing, May 8, 1843, DI 1: 7–12.

ever of the American claim to special friendliness and to difference from Europe.

The Chinese did recognize, however, the validity of the image of the United States as a rising commercial, industrial, and technological country, with a practical and scientific knowledge basic to military power. The easy triumph of the flowery flag devils in the Spanish American War, the acquisition of an Asiatic dependency, and the effective participation with Europeans in the suppression of the Boxer aggression, strengthened the impact of that image.

In the twentieth century other aspects of American life and culture were again emphasized in China and we may believe that some of these later presentations or images of America helped to counteract the mixed fear and admiration of the United States as an industrial and military power that had waxed strong in the late nineteenth century. We can only guess to what extent the decline of western influence in China has been related to earlier unfavorable Chinese images of the west.

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REPRODUCTION IN THE MINK (MUSTELA VISON)

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INTRODUCTION

For many years Frank G. Ashbrook, of the Section of Fur Resources, and Carl G. Hartman, then of the Department of Embryology, Carnegie Institution of Washington, discussed the possibilities of studying the reproductive cycles of the fur-bearing animals. Through their vision and effort a grant was secured from the Bankhead-Jones Special Research Fund of the U. S. Department of Agriculture to undertake a study of reproduction in the mink (*Mustela vison*).

Before the project opened, extensive collections of reproductive tracts had been made at pelting time. These were studied in toto, then sectioned. On February 1, 1938, the project was officially opened with headquarters at Baltimore. Every facility and courtesy were extended by the Department of Embryology, Carnegie Institution of Washington, and by Johns Hopkins Medical School. In June of 1938, headquarters was transferred to Swarthmore College, Swarthmore, Pennsylvania. On July 1, 1941, the project was transferred to the Section of Fur Resources, Fish and Wildlife Service, United States Department of the Interior. A year later smaller appropriations forced curtailment of the work. From March

* In cooperation with the U. S. Department of the Interior and the U. S. Department of Agriculture.

1943 to November 1944, O. P. Pearson carried on while the writer was absent. In 1946 the work was transferred to the Bureau of Animal Industry, United States Department of Agriculture.

A monograph on reproduction is never complete and is never finished. Although the author realizes the shortcomings of this study all too well, this monograph is published to aid those who are studying the breeding of mink. Constructive criticism of colleagues working with other mammals is desired. In another ten years a more complete understanding of reproduction may be ours.

Much excellent research has been done on mink in Sweden. Johansson and Hansson lead in the amount of published work but other students of Johansson have contributed also. Some work, chiefly on feeding, has been done in Norway and some work has been published in Russia by Starkov. Many good short papers have been published in both the United States and Canada, but aside from Shackelford's ('50) "Genetics of the Ranch Mink" nothing as comprehensive as Hansson's ('47) "The Physiology of Reproduction in the Mink with Special Reference to Delayed Implantation" has appeared here. There are several good books and booklets on mink ranching, less on research than on practical observations. At this writing fundamental research is being carried on in at least four places in the United States for the industry is well organized and is anxious to promote the work. One problem in connection with writing a monograph of this type arises from the method of publication in trade journals. Some articles are published and republished many times, some times with a change in title. Many times an article will appear simultaneously in several journals. An attempt has been made to cite the journal in which the information first appeared but this has not been possible in some cases. References marked "anon." are usually the work of the editor of the journal based on information furnished him by correspondents.

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TAXONOMY

The mink belongs to the subgenus *Lutreola* Wagner of the genus *Mustela linnaeus*. The classification and range followed here are mostly from Miller ('24). Miller appears to have based his statements on the revision of the subgenus by Hollister ('13). Throughout this paper the mink will be considered to be *Mustela vison* without regard to subspecies. The mink on fur farms of this country probably represent six or possibly more subspecies so intermingled and interbred that no separation is now possible. The subspecies represented are most likely: 1, *Mustela vison vison;* 2, *M. v. lowii;* 3, *M. v. letifera;* 4, *M. v. lacustris;* 5, *M. v. ingens;* 6, *M. v. mink.*

(1) *Mustela vison vison* ranges through eastern Canada south to Northern Pennsylvania but is not found on the coast south of New Brunswick. This may be the forerunner of the so-called "Quebec," "Labrador," or "Eastern" types of the fur farms.

(2) Another subspecies, *M. v. lowii,* which was not recognized until 1945 (Anderson), is found in Northern Quebec and Labrador and it too may have entered into the early breeding of the "types" ascribed to *M. v. vison.*

(3) While mink breeders do not claim any type to have originated from *Mustela vison letifera,* there is probably some mixture of this subspecies

in certain domestic stocks. The range of this subspecies from northern Wisconsin and northern South Dakota, south to northern Illinois and Missouri includes territories where many mink farms are located. It seems reasonable to assume that some native stock has been mixed with imported "Easterns," and possibly "Yukons."

(4) Much of the same can be said of *Mustela vison lacustris* which ranges through the interior of Canada from Great Bear Lake and the western shores of Hudson Bay south through Alberta, Saskatchewan, and Manitoba to southern North Dakota.

(5) *Mustela vison ingens* is generally considered the ancestral form of the large "Yukon" or "Alaskan" mink. The range of this subspecies touches that of the *Mustela vison lacustris* in the lower Mackenzie Valley and that of *Mustela vison melampeplus* near the base of the Alaska peninsula. It grades directly into those two subspecies (Hollister, '13). Probably all three of these subspecies have been used as breeding stock under the name "Yukon" (Gothier, '41).

(6) Another subspecies, *Mustela vison mink*, may have been used in breeding, for some of the finest wild-caught specimens belong to this subspecies. Ranging as it does over the coast of New England south to North Carolina it is classed as an "Eastern."

It is probable that *M. v. energumenos* and *M. v. melampeplus* may have contributed somewhat to a few herds but it is questionable whether animals from these subspecies were widely used in building up the mink on fur farms. With mink raising being carried on in California, Oklahoma, and Louisiana it is always possible that *M. v. aestuarina* and *M. v. vulgiraga* may have been incorporated in a few herds but little or no breeding stock is sold from the last two areas; hence these subspecies have not been contributors to the mink on fur farms.

Shackelford ('49) says that most persons acquainted with the rise of fur farming believe that three subspecies *M. v. vison, M. v. melampeplus,* and *M. v. ingens* were used most extensively in building up the herds. Gothier ('41) seems to agree with Shackelford and adds that 90 per cent of all good mink on ranches in the United States are cross breeds. Later Shackelford ('50: 2) in his comprehensive book on the genetics of mink said "present day ranch mink have been derived from many if not almost all" of the subspecies listed by Anthony ('28). He points out that the practice of introducing wild caught mink into ranches has increased during the past few years.

Mink breeders claim to recognize several types of mink. They speak of "Labradors," "Easterns," "Quebecs," and "Yukons" much as cattle breeders speak of various breeds. The names reflect the geographical "race" of the supposed ancestors of each type. While most of the mink used in this study were "Easterns," it is believed that there is little difference in the reproductive physiology of the several types, although "Alaskans" are reported to tend to come in heat later than "Easterns." Without doubt some ranchers have developed herds that are distinctly different from the average mink but these seem to be strains rather than breeds.

Taxonomically, the farm-raised mink is undoubtedly a hybrid. The variations observed in a large series of skulls taken from animals of known sex and age, such as can be secured at pelting time, are striking. In such a series of skulls not enough uniformity exists upon which a diagnosis of subspecies can be made even though the herd may be listed as "pure Easterns," "pure Labradors," or "pure Yukons."

Size is not dependable as a criterion of subspecies. Selection and possibly improved feeding have tended to change the size of the ranch-raised mink, for the trade pays a higher price for large skins, other factors being equal. Some breeders have produced a "pure Eastern" that is as large as or larger than the "pure Yukon" of other breeders. Conversely, some "pure Yukons" average smaller than some strains of "pure Labradors." Before fur farming was practiced, Coues (1877) observed that the mink from Washington Territory and the Upper Missouri (*Mustela v. letifera*) were larger on the average than others he had seen, but added that some specimens of the ordinary "dark mink" (*Mustela v. mink*) were as large. Coues recognized that very considerable individual variation in size and color existed within all subspecies even though he was inclined to treat subspecies as species.

Nor can coat color be relied upon, for the demands of the fur trade have led to the selection of darker individuals for breeding stock and to rearing the animals in deep shade. This darker color is not "fixed," for litters are seldom uniform in color except in a few inbred strains. Length of guard hair and underfur, color of undercoat, "silkiness," as well as other characteristics, all may vary in a given litter. That this variation is the natural

condition and not the product of breeding practice is indicated by the great variation found in wild-caught animals of the same subspecies; one must remember, moreover, that season or "prime" has something to do with the characteristic of the coat. Greater variations are to be expected in wild-caught animals which are trapped over a season of several months, while ranch-raised stock are killed when the pelt is prime and, theoretically, more uniform. Nevertheless the pelts from many mink farms show as great variation as those from animals caught in the wild, ranging from light brown to very dark. Since most stocks are heterozygous for fur characters even after years of selection, it is evident that coat color cannot be relied upon in attempting to determine the various subspecies from which various "strains" or "types" arose.

Although breeding, as it is now carried on by the better ranches, tends to produce an animal that is becoming more and more uniform, it is at the same time obscuring the characteristics that make subspecific identification of the ancestral stock possible. It is also, but this need not detain us here, developing many mutant types, some of considerable promise from the standpoint of the fur trade.

At least one group of mink breeders recognized the difficulty of determining the types of mink and moved to simplify the complex system of naming. They adopted the following classification for mink exhibited at the Michigan-Ohio show:

Eastern type Mink—Males 2–3 pounds,
Females 1¼–1¾ pounds.

Yukon types Mink—Males 3 pounds and up,
Females 1¾ pounds and up.

This classification has not been accepted by other groups even though it is simple and workable. However, no attention is paid to "this arbitrary weight classification in the major live mink shows" (Shackelford, '50: 3).

Moreover, the impact of mutation color phases may have destroyed any tendency toward the formation of "breeds" of mink for there has been a very free exchange of breeding stock which has broken up homogenous herds (Shackelford, '50).

With the foregoing discussion in mind there is no alternative but to assign the mink under discussion to the species *Mustela vison* without subspecific designation. It must be remarked in passing that the interstate and international shipment and the subsequent release or escape of animals will make the work of the taxonomist more and more difficult as subspecific crosses occur, and will add greater importance to collections made before fur farming became an industry.

Charles Rich established a fur farm on which he kept mink at New London, Wisconsin, in 1867 (Anon. '45*a*). The mink has become an important fur-farm animal. Estimates as to the number of mink pelts produced run as high as 2,000,000 in United States, 600,000 in Canada, and 700,000 in other countries (Broyles, '50: 35). The technical details of the care and breeding of these valuable animals have been worked out empirically on these fur farms and at the U. S. Fur Animal Experimental Station, Saratoga Springs, New York, over a period of years.

MATERIALS AND METHODS

The material used in this work came from various sources. Reproductive tracts from a few wild-caught mink were available, but most of the material was from ranch-bred animals. At pelting time large series of reproductive tracts were secured from both kits and adults. In most cases the reproductive history of the pelted adults was known. Animals injured or killed by accident and those dying from disease were used when their condition and history warranted.

It would have been more satisfactory to have used one of the older established inbred lines in this work. Failure to do this may explain the great variation found and may explain where observations differ from those of other workers. For instance, it is very probable that Johansson, Apelgren, and Hansson used animals that were not as divergent in origin since they were from stock originally from fewer sources than the animals used in this work.

Furthermore, after they were established in Sweden the "Quebec" and "Yukon" mink were not mixed. However, the pure strains are not available in large numbers and we had to use what was available. Moreover, in using breeding data from many farms no segregation of types or strains was possible. While this is not a satisfactory procedure experimentally it was the only course that could be followed under the circumstances.

By far the greatest amount of material was secured from animals in the laboratory. These animals were bought from several breeders or were furnished by the U. S. Fur Animal Experiment Station, Saratoga Springs, New York, or were gifts from cooperative breeders. They were delivered to us in individual cages before the breeding season with data on each as to age and

reproductive history. Altogether, more than 400 animals were maintained at Baltimore and Swarthmore for a longer or shorter period. These animals were kept on an open roof, protected somewhat by a parapet, but otherwise exposed to the elements. In addition to these animals materials were secured from fur breeders and the U. S. Fur Animal Experimental Station.

Most materials for study were secured by surgical operation. Nembutal was used at first and, while satisfactory, was slow in its initial effects unless given in such large doses as to keep the animal under for a longer period than was considered advisable. The dosage given by subcutaneous injection was 0.6 cc. per kilogram of body weight. Later, ether anesthesia was used exclusively.

The mink is an excellent subject for experimental surgery. A female will breed within 18 hours of the removal of an ovary and part of a uterine horn. While sterile methods were usually employed this does not appear to be necessary. The anesthetic seems to be more critical than the surgery. In our operations the ventral musculature was closed in either two or three layers using black cotton thread and interrupted stitches and then the skin was drawn together from the inside so that the knots in the interrupted sutures were protected by the pulling together of the edges of the skin. A continuous suture is run so as to pull together the edges of the skin and add to the protection of the underlying knots finishing the closure. The thread of this last will come out without any interference from the operator. Mink do not pull out such closures. As many as three laparotomies have been done on one animal without any difficulty. The cotton thread is not absorbed nor does it infect and a few weeks after the operation the scar is hard to locate. Scars from previous years can be located from the inner surface of the skin.

Immediately after removal, the tissues were placed in normal saline solution and examined as soon as possible. Notes were made on gross appearance and color. After removal from the salt solution the material was fixed in Bouin's fluid or in Zenker-formal mixture. Some material secured at pelting time was fixed in 10 per cent formalin, but this method was not as satisfactory as fixation in Bouin's, so was used only when Bouin's was not available. Post-fixation processes were the usual transfers to alcohol. Most tissues to be sectioned were embedded in paraffin after passing from alcohol to dioxan. Some ovaries were stained in toto with alum cochineal before embedding, and after sectioning were counterstained with methylene blue. Other tissues were sectioned, stained with alum hematoxylin and counterstained with acid fuchsin, or hematoxylin counterstained with eosin was used. Sections were cut 10 micra thick and mounted as serial sections. In all, more than 300 ovaries were sectioned serially. In addition to these ovaries a large number of slides containing sections of vaginae, uteri, and oviducts were prepared.

Ovaries and other tissues were weighed after fixation and after they had been in 70 per cent alcohol for at least twenty-four hours.

Vaginal smears were taken with a spatula at first and later with a pipette. During the first season the film was air dried, taken through alcohol, and stained with hematoxylin and counterstained with eosin. Later air dried films were stained by using a modification suggested by Ruth McClung Jones of Ucko's method (Ucko, '38). The technique is as follows:

1. Air dry the film.
2. Drop on May-Grunwald ..... 3 minutes
3. Dilute to 1/2 ..... 1 minute
4. Pour off and cover with Giemsa diluted ..... 15 to 20 minutes
5. Rinse and leave in distilled water .. 1 minute
6. Mount for permanent record.

Entirely cornified vaginal epithelium cells are stained red, partly cornified cells violet, and noncornified cells blue. Slides prepared in this way, then dried and covered with isobutyl methacrylate could be kept for semi-permanent record.

HOUSING AND FEEDING

The pens used were 48 inches long by 30 inches wide by 14 inches high, excepting the front which was 12 inches high to accommodate a sliding, galvanized, dropping pan at the bottom. Each pen was constructed to provide three compartments, each 16 inches by 30 inches. The top and sides were made of 14½ gauge, 2 by 1 inch welded wire mesh. The floor was made of 14½ gauge, 2 by ½ inch welded wire mesh with the horizontal wires spaced half an inch apart, center to center. Each pen was equipped with three, half pint capacity, pressed, galvanized steel cups for water, one for each compartment. Each partition was provided with a galvanized steel, sliding dropping pan which could be removed for cleaning. The pan was 31 inches long with half-inch sides and slightly

less than 16 inches wide in order that it could slide in and out freely.

Three units, housing 9 animals, with galvanized iron partitions between individual pens, flush top and bottom, were used for isolating animals.

The nestboxes used were 11 by 11 inches with a roof 11 inches above the floor or bottom in front, sloping to 9 inches in the rear. The top was made of galvanized iron, gauge 20, hinged to the front of the box. Eight inches from the bottom of the inside was a frame of mesh wire, gauge 18. This frame was removable in order that bedding could be placed in the box. The opening in front was 3½ inches square. The box was constructed of half-inch redwood.

The experimental animals were fed a diet consisting of 70 per cent raw horse meat, 5 per cent vegetables, usually carrots or tomatoes, 1 per cent cod liver oil, and the remainder a complex mixture, the formula of which is given below:

Breadmeal	100 pounds
Oatmeal	100 pounds
Wheat germ	100 pounds
Fishmeal	100 pounds
Skim milk powder	50 pounds
Alfalfa leafmeal	50 pounds
Soybean oilmeal	50 pounds
Linseed oilmeal	25 pounds
Wheat bran	25 pounds
Yeast (inactive)	25 pounds

Five per cent of the horse meat consisted of liver, heart, or spleen. Occasionally, canned fish or canned horse meat was substituted for the raw meat. During the breeding season the animals were fed morning and evening. When the dry mixture was not available commercial mink food was used, since its formula was very similar to our own mixture.

HANDLING

When animals were to be transferred they were driven into the nestbox and moved in it. For close examination the animals were caught in a small wire catching cage with a movable bottom so made that the animal could be held firmly between the bottom and the top of the cage. As we became more familiar with the animals they were caught by hand, using horsehide gloves. After frequent handling with gloves the animals lost their fear, no longer discharged their musk nor fought. However, even the gentlest mink never neglected to bite any convenient bit of flesh or clothing that came within reach.

In breeding, the female was confined to her nestbox, the nestbox removed and hung on the cage of the male, and the door of the nestbox was closed after driving out the female.

The most convenient way to drive a mink is to blow on it; when this failed, as it did from time to time, mink were driven by inserting a stick into the nestbox.

THE FEMALE

Although the mink is in many respects a highly specialized mustelid carnivore, the gross anatomy of the reproductive system of the female does not differ greatly from that of the generalized carnivore type. It must be borne in mind that all of the parts of the system are small during anestrum and then grow enormously at the approach of the breeding season.

OVARY

Hansson ('47: 20–21) published the first description of the mink ovary. Quite properly he compares it with the ovary of the ferret as described by Robinson ('18). The ovaries of the mink are roughly bean-shaped, the cranio-caudal length usually exceeding the other measurements. In young animals that have not bred, the ovary is considerably more variable in shape than in later life, with a distinct tendency towards the formation of lobules, and consequently a marked departure from the ovoid shape (fig. 9). Some ovaries are smooth without projecting follicles or corpora lutea but others tend to retain the lobes throughout life. Occasionally a lobule may contain a large follicle giving the entire lobule the appearance of a single projecting follicle (fig. 24).

The size of the ovary of the adult varies at different periods, being small during the long anestrum, increasing in size as the breeding season approaches, and becoming largest about two weeks before parturition (figs. 10, 25). Great differences are observed in the amount of growth that occurs during estrus. A distinct lateral expansion often takes place, and the lobate condition usually disappears as though the lobes were engulfed by the expanding body of the ovary. During the breeding season follicles may project from the surface of the ovary, breaking up the otherwise smooth outline (figs. 23, 24).

Because of the lobate structure of many of the ovaries, they were not only measured but also weighed after fixation. Little difference was found between the weights of left and right ovaries of the same animal when both ovaries were active. The greatest difference observed was in a female with ovaries weighing 0.75 and 1.66 gm. Usual

weight differences were within the limits of errors in technique. In mature, sexually active animals during the breeding season, ovaries weighed from 0.30 to 1.66 gm., there being some slight relationship between body weight and ovarian weight. The average weight of 14 ovaries taken from March 2 to March 26 was 0.652 gm. If the largest ovary is excluded, the average was 0.601 gm. Ovaries removed during anestrum average about one-half as heavy, or 0.30 gm. One ovary removed during the breeding season from an animal that refused to mate weighed 0.22 gm. This was the smallest ovary observed in a normal adult mink. An ovary weighing less than 0.30 to 0.40 gm. during the breeding season is inactive.

The Germinal Epithelium

The germinal epithelium of the ovary of a kit that died 3 hours postpartum had the appearance of a simple, cuboidal epithelium. Poor fixation made cytological detail too obscure to describe. By the first of September, which is approximately 4 months after birth, the germinal epithelium is still simple cuboidal, the nuclei are round or oval, strongly basophylic. The cytoplasm is scanty. This condition persists during maturity (Hansson, '47: 29).

The Germ Cells

In the new-born mink the germ cells appear to be very few. At 70 days ovogonia are scattered through the cortex but are most numerous near the outer surface of the latter, where they may occur in groups of 20 to 50. This grouping suggests the occurrence of typical repeated ovogonial mitosis. Some ova are present in the medulla. Each ovogonium is invested by a single layer of flattened epithelial cells. The ovogonia have large round nuclei and abundant, apparently deutoplasmic, cytoplasm. Ovogonia continue to increase in number until October or November, for by the end of November the ovaries of both kits and adults are rather similar in appearance (fig. 9).

Internal to the germinal epithelium the spindle-shaped cells of the tunica albuginea are arranged in a definite envelope. The tunica appears to be more dense in ovaries of pregnant animals than in those killed at any other time (fig. 25). Most of the fibers of the tunica are parallel to the surface of the ovary while some bend inward, dividing the cells of the cortex into columns and nests. Other fibers pass out from the hilus in the same manner. Blood vessels follow some of these lamellae into the cortex. The main mass of the cortex consists of interstitial cells. Most of the primitive ovarian follicles lie near the periphery in the immature ovary; in the anestrous ovary the ovarian follicles lie deeper (fig. 10).

Medulla

In the new-born mink the medulla is not well differentiated from the cortex; it extends from the hilus into the body of the ovary, forming but a small portion of the organ. The hilus is located diametrically opposite the thin side of the bursa. Later (70 days postpartum) the hilus is composed of a compact mass of connective tissue, containing blood vessels and other structures, and is directly continuous with the ovarian bursa. The medullary region can be distinguished easily because it is compact, composed chiefly of small cells with strongly basophilic nuclei, and contains few germ cells; the germ cells present are of the "primitive" type. Up to 70 days postpartum most of the medullary cells are still organized into long slim columns converging irregularly toward the hilus. These columns represent, probably, the embryonic medullary or primary sex cords. Owing to the twisting course of the columns these cords are sectioned in all planes.

Within the medulla and close to its hilar margin are tubules which have the characteristics of rete canals; i.e. simple squamous epithelial lining, irregular and tortuous lumina, free intercommunication, and general convergence at the hilus. The fact that these tubes are located in the medulla would suggest that they are medullary tubules, but their whole appearance is that of the rete canals seen in the ovarian hilus of many mammals. With advancing age the medullary tissue becomes less conspicuous as differentiation progresses, and with this change the rete canals are reduced in size and number until the medulla forms proportionately but a small part of the ovary.

The Prepubertal Ovary

Mink are usually born in late April or early May. From the end of October the ovary contains ovocytes that have entered upon the growth phase. These large follicles average 0.4 mm. in diameter, the largest measuring as much as 0.6 mm. before becoming atretic; because of the smaller size of the prepubertal ovary they appear to be larger than the largest follicles found in adult ovaries at the same time of year. Developing follicles from the earliest recognizable developmental stages to degenerate follicles are found in the same ovary after

the ovary once becomes active. Large numbers of primordial follicles lie in the cortex, chiefly near the periphery of the ovary (fig. 9). From this time on to the breeding season the ovaries present this condition, indicating that ovarian activity is maintained at approximately this level during the first winter.

The Anestrous Ovary

The anestrous ovary appears to differ from the prepubertal ovary chiefly in its larger size and greater number of developing follicles (fig. 10).

Throughout the functional life of the mink ovary, new groups of follicles continue to appear. Neither the absence of estrus nor the presence of corpora lutea suppresses completely the formation of new follicles and their very considerable growth. In the anestrous ovary, follicles develop to 0.37 to 0.65 mm. (average 0.45 mm.) in diameter before atresia overtakes them. Follicles found in ovaries containing mature corpora lutea measure approximately 0.38 mm. in diameter except in occasional cases following early mating, when follicles of greater size usually develop. Corpora lutea formed from follicles that ovulate early in the season do not inhibit follicular growth at as early stages as do corpora lutea from follicles that rupture later in the breeding season. But as the season passes and the early corpora mature their inhibitory effect is as great as those of later-formed corpora.

Primary ovarian follicles appear at all times of the year in the ovary of the adult mink, but there is a conspicuous increase in numbers during the breeding season. In ovaries removed during proestrum the primordial follicles are more numerous than during anestrum but not so numerous as during estrus and pregnancy. At the time of high ovarian activity not only are follicles of large size present, but also greater numbers of primary follicles appear than at any other part of the cycle. The formation of these small follicles is not completely inhibited by the presence of follicles ready to rupture, by corpora lutea, or by early pregnancy (figs. 26, 28). After the breeding season, unless pregnancy or pseudo-pregnancy intervenes, the number of primary follicles drops to approximately the number found in anestrum. During pregnancy or pseudo-pregnancy only a few primordial follicles are formed, but a few weeks after termination the anestrous condition is reached and persists until the onset of the next breeding season.

In contrast with the small number of primordial follicles found in the ovaries of anestrous adults in October, the prepubertal ovary contains large numbers of such follicles. Too few ovaries of prepubertal animals were available to determine the time of origin of the primordial follicles. On the basis of the small number of ovaries examined the tentative conclusion is advanced that there may be an increase in the production of primordial ova as well as of primary follicles before puberty, which corresponds somewhat to the increased production during the breeding season in adults. By the end of November the pubertal ovary is like the anestrous ovary of the adult.

Oogenesis

Ova can be identified as such when they have attained a diameter of 20 micra. As in all mammals, growth is then rapid as compared with follicular growth until the diameter reaches 90 micra, and thereafter the ovum reaches the approximate maximum diameter of 100 micra.

In the mink, proliferation of ova from the germinal epithelium apparently goes on throughout the year, even during pregnancy. This statement is based upon the occurrence of young follicles containing oocytes, rather than upon an investigation of the seasonal activity of the germinal epithelium and the formation of oocytes. However, this origin is relatively clear when primordial ova occur in "nests." These nests may be within the perimeter of, or may protrude from, the surface of the ovary. In some cases, the first of which was sent to us by H. W. Mossman, dense clumps of primordial ova project so far that they appear to be wart-like. In these cases the tunica albuginea separates the ova from the cortex. The dense tunica found during pregnancy or pseudopregnancy may be correlated with the decrease in oogenic activity of the germinal epithelium, or the tunica may form a barrier to internal migration from the epithelium. Thus the tunica, rather than lessened oogenesis, may account for the small number of young ova found after parturition. Toward the end of the delay in implantation while the corpora are relatively inactive and toward the end of lactation the proliferation of ova increases to such an extent that it appears that most of the primordial ova may be developed at these points in the cycle. In the young mink this proliferation occurs in October of the first year.

Biovular follicles occur rather frequently. None of those observed approached full pre-inseminal growth. This may be because of unselective elimination before the proper stimulus that would have caused them to grow was received, rather than their elimination because they were biovular.

The Follicular Cycle

Primary follicles appear most abundantly in the cortical zone. A description of follicular development in the mink is given by Hansson ('47), in which he recognizes 9 stages. The following descriptions differ somewhat from his findings. The follicles may be more or less evenly distributed or may occur in large numbers chiefly near the hilus, as noted by Robinson ('18) in the ferret. Hansson ('47 : 36) says that the primitive follicles lie in the tunica albuginea or in the strands of connective tissue which turn inwards from it to the cortex. The difference in our views is due, possibly, more to differences in interpretation than to observation, Hansson calling primitive follicles the structures here called oocytes. As has been pointed out, after the first fall primary ovarian follicles appear at all times of the year, but only a small number ever reach full pre-inseminal growth. During the long anestrum, follicles of different sizes are scattered sparsely throughout the cortex of the ovary (fig. 10). During anestrum some of these follicles develop to approximately 0.5 mm. in diameter and have a well defined antrum of considerable size. In the smaller follicles, that is, follicles of less than 0.37 mm., the ovum is located centrally, for the antra are not well developed, while in the larger follicles the ova are found on a broad cumulus which is to one side of the antrum. Even at this early stage (0.3 to 0.4 mm.) there is a tendency for the cumulus to form in the part of the follicle nearest the center of the ovary. In the larger follicles present in anestrum the ovum has a distinct zona. The germinal vesicle may be centrally located or to one side of the ovum; the nucleus contains an eccentric nucleolus. Cumulus cells varying in depth from 2 to 10 layers surround the ovum, but no corona formation takes place. The nuclei of the cumulus cells are more or less centrally located.

In these follicles the stratum granulosum is approximately 8 cell layers in thickness. The granulosa cells are small and rounded so their nuclei appear to be very closely packed. At this stage the basal layer is like the rest of the granulosa, showing none of the columnar form which is attained in larger follicles. The basal layer, however, differs from the other cells of the granulosa in having the nuclei located basally instead of being nearer the center of the cell. While the granulosa is sharply distinct from the theca, the basement membrane or external limiting membrane is not so distinct as in larger follicles. At this stage the theca, too, forms a distinct entity but is not so distinct as in larger follicles, since the cells are not greatly attenuated.

The Proestrous Follicle

With the onset of the short annual breeding period, some of the many small follicles grow beyond the stages found in the anestrous ovary. Instead of atresia setting in when the follicles reach about 0.45 mm. in diameter these follicles grow to a diameter of approximately 1.0 mm. How long these follicles persist is not known, but, if ovulation does not take place, the early full pre-inseminal or estrous follicles become atretic and others develop to the same size (fig. 12). These "waves" of maximum follicular growth are limited to the short breeding season. During this period adequate stimulation results in ovulation.

Follicles that grow to a diameter of about 0.7 mm. may be considered proestrous follicles. In such follicles the antrum is large. The ovum is most frequently located in the portion of the follicle near the center of the ovary, or it is probably more accurate to say that the antrum develops toward the periphery of the ovary. This appears to be for mechanical rather than for physiological reasons. As the antrum grows the cavity is more or less ovoid, with the smaller portion of the ovoid containing the ovum and cumulus near the center of the ovary, and the antrum expanding the larger end of the ovoid. As the follicle develops it may migrate to the surface of the ovary, becoming more and more globular in shape as it does.

The changes that take place in the follicle during proestrum have been anticipated in the description of the follicles found in the ovary during anestrum. To reiterate, the nucleus comes to lie at the periphery of the ovum, the nuclei of the cells surrounding the ovum begin to migrate peripherally in cells that now form the corona, while the basal layer of the stratum granulosum approaches the columnar. The change in size of the ovum in relation to the size of the follicle is shown in figure 1.

The Follicle of Full Pre-inseminal Growth

While some follicles of full pre-inseminal growth became larger, the average may be taken as 1.00 mm. At this stage the ovum with its corona is either free or attached to the cumulus by tenuous bands of cells, while the germinal vesicle is located at the periphery of the ovum and the chromatin material is diffuse within the nuclear membrane. There is no indication of polar body formation.

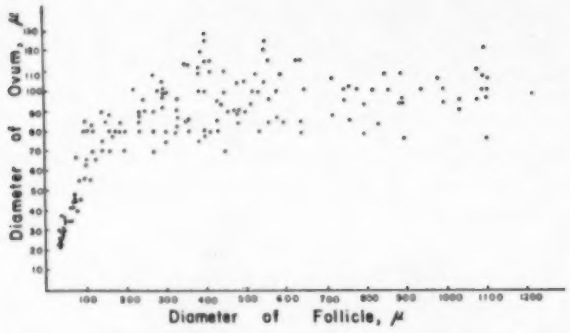


FIG. 1. Relationship of ovum growth to follicle growth.

The most spectacular change is the formation of a conspicuous corona radiata (fig. 14). This is formed by elongate cells in which the nuclei have migrated to the periphery. Cells of the cumulus, other than those that form the corona, delaminate at the level of the coronal perimeter and are not differentiated by nuclear migration, retaining, therefore, their appearance of true granulosa cells. Apparently the corona radiata reaches full development earlier in relation to the stimulus of copulation in the mink than in the ferret or cat. To judge from the appearance of the coagulum in the fixed follicle of this stage, only primary follicular fluid is present.

The formation of the corona radiata follows a rather regular pattern. Some 30 hours or so after copulation the ovum is freed from the cumulus. This is accomplished by the development of an antrum within the cumulus; the "spider web" type so frequently seen in the rabbit is not common in the mink. Starting in the cumulus between the ovum and basement membrane, but closer to the ovum, the antrum grows until it surrounds the ovum, separating the ovum and corona from the cumulus cells (fig. 13).

While the corona has been forming and the cells of the cumulus are scattering, there is a marked rearrangement of the cells of the statum granulosum. The basal cells become distinctly columnar and the nuclei of these cells migrate away from the basement membrane, a change somewhat resembling the changes noted in the cells forming the corona. The other granulosa cells are arranged much as before, but the depth of the granulosa is less by several cell layers. Both the degree to which the columnar condition develops in the basal layer of cells and the depth of the granulosa cells vary from follicle to follicle, reaching an extreme point where only a few rounded cells overlie the columnar basal layer. In such follicles the nuclei of the basal layer are conspicuously apical. Before this extreme condition is reached, the granulosa is deepest at the region of the cumulus, an effect which is heightened by the greater development of columnar cells in this region. While the cells from the cumulus scatter, the higher cells of the basement layer of the granulosa apparently persist. Oliver P. Pearson, who has studied several of the ovaries of this series, suggests that the greater development of the basement layer is under the influence of the ovum, citing that in follicles adjacent to each other the granulosa cells lying between two ova become even higher than the basement cells in non-adjacent follicles. Under the granulosa the basement membrane is distinct. Immediately under the basement membrane the theca contains a well-developed vascular network of sufficient size to insure an active circulation. The theca, which is fairly thick, appears to consist of much-attenuated fibroblastic cells and epithelioid cells, the epithelioid cells being similar in many ways to interstitial cells. Atresia takes place sometime before this stage is reached, or at this stage, for no further development occurs unless sufficient stimulation brings about pre-ovulatory changes (fig. 18).

Post-inseminal Follicles

The number of animals in the series showing pre-ovulatory changes is small. This should be kept in mind since a larger series probably would have shown more variation than is indicated by the foregoing description. A further caution is necessary in considering the animal used as a basis for the last stage before rupture; this mink had received a total of 21 I.U. of Theelin between February 8 and February 20. The ovary was removed 9 days after the last injection.

As compared with follicles of full pre-inseminal growth, little or no increase in the size of the follicles is detectable 2 hours post-coitum (fig. 16), nor are the internal changes between the follicles of full pre-inseminal growth and post-copulatory growth uniform from follicle to follicle. No method was found to differentiate at this early stage between the follicles that would ovulate and the follicles that would fail to ovulate, since atresia was not detected. The differences observed between follicles of the same post-inseminal age may be due to failure to recognize follicles that would and those that would not rupture; some follicles are doomed to atresia but which these were could not be determined. The cumulus may or may not be attached; if attached, the attachment is slight.

In those follicles in which attachment still exists, the germinal vesicle is surrounded by a distinct membrane, the granulosa is deep, the basal portion columnar, and the basement membrane distinct. If, on the other hand, the ovum is free from the cumulus the chromatin of the ovum has condensed into a single mass with the nuclear membrane either disappearing or gone, the thickness of the granulosa is less and all but the portion derived from the cumulus is columnar. The basement membrane is beginning to disappear. A few transitional cells, somewhat luteal in appearance, are scattered about in the granulosa. No changes have taken place in the theca.

Eighteen hours after stimulation the follicles show considerable change. The ova may be all but free from the cumulus or still rather firmly attached. The nucleus is eccentric in the ovum, the corona radiata can be recognized, but the nuclei of the coronal cells have not started to migrate away from the ovum, and the coronal cells are only slightly more columnar than the granulosa cells that still surround them. The basal layer of the granulosa cells is not columnar, but there is no indication of luteinization.

Thirty-eight hours post-coitum the follicles still show considerable variation in their structure (figs. 41, 42, 43). The follicles average about 1.5 mm. in diameter, which is half again as large as follicles of full pre-inseminal growth. When more than 4 or 5 maturing follicles occur the average size is smaller, both at insemination and before rupture. In the smaller follicles, in what may be termed the spindle stage, the ovum surrounded by its corona is free in the antrum. No polar body has been formed but a spindle is present. The chromosomes are either in metaphase or early anaphase. Two centriole-like structures are present. The granulosa is no longer columnar and many granulosa cells appear to be undergoing luteinization. The basement membrane has all but disappeared. Vascularization is more intense in the half of the follicle that is nearer the center of the ovary. Apparently the blood vessels grow out from the branches that enter at the hilus and vascularization proceeds from the center to the periphery as the vessels surround the follicle. A few blood cells are in the liquor folliculi. The corona radiata consists of cells that are long and slightly club-shaped (fig. 41) with nuclei arranged at the periphery.

The next stage, in this case described from follicles in the same ovary, may be called the first polar body stage, for the ovum is in first division (telophase) and the first polar body is separating (fig. 42). The free ovum is surrounded by a corona composed of cells that appear to be slenderer at the base and not so firmly attached to the ovum. A diffuse web of cast-off cumulus cells may or may not surround the corona. Luteinization of the granulosa cells has progressed farther, and the granulosa has lost all semblance of columnar structure. Vascularization of the granulosa has progressed far enough for blood to escape into the follicle. That this is blood is substantiated by the presence of red blood cells with polymorphonuclear leucocytes among the corpuscular masses. Several such masses may be present within a follicle.

The next phase in maturation is described from an ovary removed 50 hours post-coitum containing 7 ruptured and 4 unruptured follicles. Two of the unruptured follicles measured 1.75 and 1.71 mm. in diameter, a considerable increase in size and quite the largest follicles in this series. In these follicles the ovum is free and is surrounded by a corona composed of cells distinctly shorter than those found earlier. The nuclei of these coronal cells are still located at the periphery, but the cells themselves are so short the nuclei lie nearer the ovum. The first polar body has been formed (figs. 44, 45), and the formation of the second polar body has progressed to the metaphase. The cells of the granulosa are well on their way to luteinization and the invasion by blood vessels of the granulosa has progressed (figs. 17, 46). The luteal cells lie around the inner edge of the follicles and project in small tufts into the antrum. Both primary and secondary liquor folliculi are present, the primary liquor occupying the portion of the follicle away from the ovum and the secondary liquor surrounding the ovum.

Follicular Succession

It is now generally conceded that, during the breeding season of the rabbit and ferret, follicles develop and retrogress in overlapping crops until ovulation (Hartman, '39). These intervals are about 2 weeks in length in the rabbit. Apparently the same phenomenon takes place in mink although both the breeding season and the follicular cycle are shorter in length. Follicles capable of development and subsequent rupture appear to be present throughout the breeding season. The overlapping is not, however, absolutely complete, particularly at the beginning and end of the breeding season.

The number of "waves" of follicles that reach full pre-inseminal growth and then become atretic because the stimulus to mature and rupture was lacking is difficult to determine, for the waves are not well defined; that is, not all follicles can be ascribed to a given wave. By the middle of the breeding season as many as three stages of atresia, determined by size and degree of involution, may be differentiated in ovaries containing follicles of full pre-inseminal growth. If these three stages of atresia represent, as they probably do, waves of follicles each of which might have ovulated had the animal copulated when a given wave reached pre-inseminal maturity, there are at least four cycles of follicular development during the average breeding season. There may be more than four cycles, for ovaries containing three stages of atresia as well as maturing follicles were found as early as March 21. Unless the maturing follicles persist for a week or more it is probable that another cycle might have taken place before the close of the breeding season. On the other hand, ovaries removed late in the season still showed only three stages of atresia, as well as follicles of full pre-inseminal growth. This may be interpreted to mean that not only are the follicles of full or near-full growth transient, but that the atretic follicles are also, for never more than three stages of atresia were identified, even though more might be expected later in the breeding season than are found in the middle of the season. Or it may mean, as mentioned above, that only four series of follicles are developed during the average breeding season.

In considering the number of waves or cycles of follicles which reach large size before becoming atretic, no proof is offered that the earliest set or early sets of follicles ever reached the stage of development where normal stimulation would have resulted in growth and rupture. However, this may be the case, for breeding experiments indicate that some early matings are fertile although not so fertile as later ones (Apelgren, '41; Bowness, '42). Moreover, in most ovaries removed during the breeding season, not more than one or two stages of atresia of large follicles are found, and some ovaries show the development of a single wave or set.

In an attempt to determine whether waves of follicles developed and, if so, how many, all the follicles and ova in one ovary were measured. The animal from which this ovary came had ovulated about 10 hours before it was removed. Seven follicles had ruptured. In addition to these follicles there were 4 atretic follicles of full pre-inseminal size and 27 other follicles beyond the primordial stage. The sizes of the ova fall roughly into three groups: 0.09, 0.10, and 0.11 mm. in diameter. The follicles also fall into three groups: 0.15 to 0.25, 0.3 to 0.6, 0.9 to 1.25 mm. The smallest ova and follicles are the most numerous, a great decrease in number taking place between these small follicles and those 0.3 to 0.6 mm. in size. In considering the possibility of follicle formation in waves the smallest follicles may be disregarded since these are present practically throughout the year. The apparent grouping of developing follicles into two later stages, plus the follicles that ovulated and the atretic follicles of full pre-inseminal growth from a previous wave, may support the the theory that follicular growth occurs in waves and that there are as many as four such waves in each season. Many other ovaries removed after ovulation showed a similar grouping of follicles into two or three size ranges.

The final proof of the transient character of the follicles by following the development of specific sets, as has been done in the rabbit by Hill and White ('33) and Smelser, Walton, and Wheatham ('34), was not done. A somewhat similar approach was made by removing ovaries several days apart. The length of one early wave was 11 days. On laparotomy on March 1 the ovary contained 7 follicles of full pre-inseminal growth. Twelve days later, 38 hours after copulation, the other ovary contained follicles well on the way to ovulation but no other large follicles. This may indicate that no follicles capable of full pre-inseminal growth except the group activated by copulation had appeared in the interval between the removal of one ovary and the second operation. It should be borne in mind that this was at the beginning of the season. Later in the season, in a case in which the interval between operations was 6 days, both ovaries contained follicles of full pre-inseminal growth; the first one, removed on March 21, contained atretic follicles that may be attributed to the crop of follicles of full pre-inseminal growth seen in the first ovary, and 14 new follicles. This may support the contention that the waves of follicular development are, at the height of the breeding season, about one week in length.

Apelgren ('41) points out that in Sweden when single copulations only are permitted, females mating from March 15 to 22 bore larger litters than those mated earlier or later in the year. On the other hand Bowness ('42) found that the variation in average litter size was too small to be considered significant, but that, of females bred

between March 1 and 8, 23 per cent were non-productive while only 18 and 17 per cent of females bred between March 9 and 16 and between 17 and 24 respectively did not produce litters. Single matings after March 25 produced smaller and fewer litters. Ovaries removed between March 9 and 25 contain the maximum number of follicles of large size.

Hansson ('45) supports this saying ". . . one finds that the greatest number of eggs are produced in the middle of the mating season while fewer eggs are produced at the beginning and at the end of the season" (p. 407, translated by Nils Haugaard).

Furthermore, as Apelgren says, the elapsed time between multiple matings, which is an expression of the willingness to copulate, is shorter during the middle of the season. This willingness indicates that the estrogen level is probably higher at this time; hence the waves of developing follicles are likely to be shorter than those that precede or follow. As mentioned before, these is some indication that willingness to mate may be correlated with follicles of full pre-inseminal growth.

While it is very probable that the willingness of a female mink to accept the male may depend on the condition of growth or retrogression of a crop of follicles, no direct correlation between the waves of developing follicles and breeding behavior was observed except by operation. These observations were not conclusive, for while the ovaries of almost all females willing to mate contained large follicles, so did the ovaries of some females that refused to mate.

Indirect evidence that mating usually takes place when follicles of full, or almost full, pre-inseminal growth are present is contributed by the vaginal cycle. The smear usually associated with copulation is also associated with follicles of large size. Since the vaginal smear reflects the estrogen level in the blood such a relationship is to be expected.

The Attainment of Ovulation

When follicles of approximately full pre-insemial growth are in the ovary, adequate stimulation usually results in ovulation. This stimulation may be the result of copulation, a struggle with another animal, or some mechanical stimulation of the vagina or cervix.

In some cases in which intromission is not achieved, the activity preliminary to copulation may bring about ovulation (Enders, '39; Hansson, '47). This has not been studied from a quantitative point of view since great variation exists between individuals. The strength of the stimulus necessary to induce ovulation in the same animal when exposed to different males or when exposed to the same male at different times during the breeding season varies also. This considerable variation at different times during the breeding season may reflect the ovarian conditions, considerable stimulation being required to bring about ovulation in the absence of follicles of full pre-inseminal growth, and very little stimulation resulting in ovulation when such follicles are present.

Hansson ('47) permitted 3 females to be mounted for at least an hour by a male "with pronounced copulative impotence." The ovaries were examined approximately 36 hours after the mounting. All 3 females had follicles ready to ovulate and 1 female had two ruptured follicles. He found, also, that in 300 matings under fur farm conditions 11 cases were found in which mounting alone produced ovulation. On the other hand each of 3 of our females was exposed to vigorous males 8 times between March 12 and March 30. The males mounted the females and attempted copulation. One of these females ovulated while 2 did not even though one had follicles of full pre-inseminal size before the last attempted mating.

Eight animals were set aside for an intensive study of the vaginal smear. Smears were made at 6:00 A.M., 10:00 A.M., 2:00 P.M., 6:00 P.M., and midnight from March 16 to April 4, except on one animal which was killed before the experiment terminated. Seven of these animals ovulated without being in contact with a male. On the other hand, the taking of smears once a day did not result in ovulation without additional stimulation in an experiment involving more than sixty animals.

In addition to ovulation resulting from copulation, fighting with a male, or from the frequent taking of vaginal smears, ovulation can be induced by stimulating the cervix mechanically with a glass rod or other instrument. Several successful attempts at artificial impregnation have been made by others using this technique to induce ovulation. Stimulation was carried on until the female lay on her side and was still. In all cases where this pre-inseminal stimulation was omitted, pregnancy did not follow insemination. In one case, laparotomy and the handling of the reproductive tract necessary to perform a unilateral hysterectomy and oophorectomy appears to have induced ovulation in the ovary left in situ. In another case stimula-

tion by faradic current or the handling incident to stimulation produced ovulation.

Ovulation was not induced by injection of estrogen, of pregnant mare serum, or of pregnant mare serum plus the gonadotrophins derived from urine of pregnancy. Subcutaneous injection of pregnant mare serum (Gonadogen) in December, January, or early February did not result in the formation of follicles that matured. The response to these injections varied from animal to animal, the same dosage producing ovarian hypertrophy in some animals and having little effect on others. Dosages as large as 15 International Units produced no observable effect in some while a dosage of 5 I.U. produced hypertrophy followed by early atresia of follicles in others. No relation between size of dose and resulting change in the reproductive tract was observed. If hypertrophy and subsequent atresia did not follow treatment ovulation followed copulation when the normal breeding season arrived.

Three females that failed to breed earlier in the season and one that had bred were given subcutaneous injections of 500 units of Antex and Physex. Two received injections of Antex on the second and fourth of May and injections of Physex on the ninth and thirteenth. The other 2 received the Physex and Antex injections in the reverse order. Not one of the treated females bred. The only ovary examined microscopically was from the animal that had bred before the injections were started. This ovary contained a few degenerating early follicles even though the ovary was more highly vascularized than the ovaries of control animals. No follicle approached the minimum size required before the stimulation of copulation would lead to ovulation.

Ovulation is not spontaneous (Enders, '39, '40; Hansson, '40). Nine females were isolated by placing them in cages separated by solid sides and placing the cages about one hundred feet away from any males. Vaginal smears were not taken. Five controls were kept with the rest of the herd under conditions that differed in that vaginal smears were made daily and the animals were not separated from others excepting by the wire of the cages. Much more commotion was experienced by the control animals, and visual, auditory, and vaginal stimuli were frequent. In neither group did ovulation take place. Not only did the isolated females fail to ovulate, but the follicles of largest size, 0.93 mm., were distinctly smaller than the largest follicles, 1.1 mm., of the five females that were kept in the usual cages within sight of both males and females (fig. 11). A slight difference in the number of follicles developed was noticed, the unbred females kept with the herd tending to develop a greater number as well as larger follicles. If the above data are sufficient to justify generalization, not only is ovulation not spontaneous but also some stimulation by the presence of other mink or by handling and taking of smears is necessary for the maximum development of follicles, both as to number and size.

Apparently ovulation is easier to induce in the mink than in the ferret. Writing about this laboratory animal, McPhail ('33: 126) says:

> One of the females ovulated as a result of the "psychic" stimulation, and the duration of the pre-coitus "courtship" must therefore be considered as a possible factor in the initiation of the ovulation-producing stimulus. In view of Hammond and Marshall's ('30) results, however, this is not likely to be an important factor.

However, the psychic factor in ovulation may be of very considerable importance in the mink. The fact that isolated females do not develop so large nor so numerous follicles as females that are kept near other animals and are handled daily has been referred to, as has the fact that pregnancy does result from intromission as brief as 2 minutes when psychic stimulation had preceded intromission. While no clear-cut record of ovulation without physical contact is on record, many females did ovulate following brief contact with a male during which the female was not seized nor intromission attempted. Contact went no farther than the usual rough and tumble which precedes normal copulation, yet this stimulus was sufficient to induce ovulation.

Following copulation, or a stimulus resembling that of copulation, the follicles of approximately full pre-inseminal growth increase in size as well as undergo other changes. This increase is not great, being about 0.35 mm. Not all follicles that undergo development to this degree finally rupture (figs. 20, 24). However, ovulation does not always follow copulation and this failure is more frequent at the beginning and at the end of the breeding season.

Relation of Stimulation to Ovulation

Ovaries removed up to and including 38 hours post-coitum contain unruptured developing follicles. Enders ('39: 122) reported that ovulation occurs between 42 and 52 hours post-coitum. This is not in agreement with Hansson ('40) who re-

ports that follicles burst "about 28 hours after copulation." In a later publication ('47: table 14) he shows that ovulation follows copulation by about 36 1/2 hours. This interval is shorter than the one we found. Hansson's method of securing the ovaries for examination probably explains the differences in our results. His mink were killed and pelted before examination so there may have been some changes due to death and even more due to the manipulation of the body during skinning. As will be pointed out later, Hansson pictures two ova (fig. 26) from the infundibulum still surrounded by cells of the cumulus oophorus. The presence of the cumulus cells may indicate that rupture of the follicles was premature. On the other hand, all the following figures are derived from mink that were anesthetized, the body opened carefully and the ovary tied off before severing. Even with these precautions it was apparent that some follicles were ruptured during the manipulations, the mink being somewhat like the rabbit in this respect (Burr and Davies, '51). Ovaries removed 43, 46, 47, 48, 49, 50, 54, 52, and 53 hours after copulation all show recent ovulation, ovaries up to 52 and 53 hours showing the liquor folliculi streaming from the follicles. All follicles may not rupture at one time. At 47 hours, 2 follicles had ruptured and one was not quite ready; at 49, 5 ruptured and 3 were not ready; at 50, 7 ruptured while 4 had not; and in three cases at 52 hours, 2 ruptured while the 4 that had not ruptured showed signs of atresia, 4 ruptured while 2 were atretic, and 4 ruptured and 4 were atretic. At 62 hours early corpora were found with the stigma closed or closing. It is possible that all the follicles that did not rupture would have become atretic, but this could not be demonstrated conclusively by observations made on ovaries removed up to 52 hours post-coitum.

The largest number of corpora lutea from a single ovulation found in one ovary was 13 and in a pair of ovaries, 6 and 10. The average number of ova shed in 50 cases was 4.9 per ovary. . Animals bred between March 18 and 26 averaged almost 6 corpora per ovary. In pairs of ovaries, the numbers ran 12 and 1, 1 and 10, 4 and 7, 6 and 5, etc., but not enough cases were recorded to obtain a significant average figure.

In many cases one or more follicles that had reached full pre-inseminal growth failed to rupture, although the majority of large follicles in the ovary had ruptured. These follicles may have been slightly atretic when copulation took place, they may not have reached full pre-inseminal growth, the stimulus to ovulation may have been inadequate to bring about rupture, or the ovum may have failed to escape with the rupture of the follicle. In one series of ovaries, 1.8 such follicles, on the average, were found in each ovary. About 10 percent of all follicles of pre-inseminal growth fail to rupture, the percentage being higher at the beginning and end of the season and lower in the middle. As many as 7 such follicles were found in one ovary in which there were also 6 well developed corpora lutea (fig. 20).

Mink are extraordinarily tough mammals as might be surmised from their breeding habits. Operative procedures affect them less than they do most animals. Laparotomy may be followed in 24 hours by copulation and copulation by ovulation. "Cats do not usually ovulate if they are subjected to laparotomy soon after mating; but they do ovulate normally if the operation is delayed until 6 hours post-coitum" (Dawson and Friedgood, '40: 419). This is not the case in mink. Laparotomy and ovariectomy immediately after copulation and two hours later did not affect normal ovulation in the ovary left *in situ*. On the other hand, ovariectomy 38 hours post-coitum may have interfered with ovulation, for in one case the ovary left in situ did not ovulate. This is not proof that ovariectomy was the cause of this failure, for frequent cases of ovulation from but one ovary of a pair were observed. When the second ovary was removed 12 days after the first laparotomy it contained follicles of full pre-inseminal growth but no corpora lutea nor large atretic follicles. Apparently no follicles of pre-inseminal growth were present in this ovary at the time of copulation, and hence ovulation was impossible.

Mink breeders are beginning to seek ways to increase the stimulus to provoke ovulation either to conserve the energies of a valuable male or in hope of increasing the number of eggs ovulated. Moyle ('50) seems to have been the first to suggest the use of vasectomized males for this purpose. In fur farm practice the vasectomized male is permitted to copulate first. After about 15 minutes he is removed and a normal male introduced. Usually the female will accept the second male without repetition of the preliminary struggle. While several ranchers used vasectomized males it is too early to decide whether or not this practice does, in fact, increase production.

Ovulation

Observations made *in situ* with a Beebe Loupe and under a binocular microscope, of ovaries in

normal saline solution at body temperature, as well as observations on serial sections, indicate that the mechanism and sequence of events in the rupture of ovarian follicles are very similar to those reported in the rabbit (Walton and Hammond, '28; Markee and Hinsey, '36; Burr and Davies, '51). Most mature follicles protrude from the surface of the ovary. At 38 hours post-coitum an avascular area appears in the protruded portion of some follicles whereas in others, apparently nearer rupture, a small papilla has developed by pushing out the avascular area. In the fresh ovary the color of this papilla is quite different from that of the surface of the follicle, for the thinness of the papillary wall is such that the follicular fluid determines this color. The papilla before rupture is translucently corinth red while the remainder of the follicular surface is darker owing to the thickness of the wall and the vascular network within the wall. If the capsule is removed and the ovary tied off after this stage has been reached, there is a tendency for one or more follicles to rupture.

When mature follicles rupture under pressure of handling and tying, or in saline solution, follicular fluid escapes slowly through the rupture point. At first the fluid is shaped like the papilla, but as more fluid passes through the opening a tenacious cap-like blob appears. This blob can be pulled out to a length of 5 cm. after which it will return to cap the stigmal opening. This cap does not appear under normal conditions of ovulation (figs. 19, 20, 21, 23), apparently because the follicular fluid reacts differently in the fluid that fills the ovarian bursa. On the other hand, follicles that rupture on being placed in Bouin's fluid show thread-like projections of coagulated liquor folliculi. Apparently these threads represent the material which in normal saline forms the cap to the stigma and which, in sections of ovaries that were removed after ovulation *in situ*, forms a mere projection from the stigma.

An hour or so after rupture the stigma is brightish red and the remainder of the surface of the follicle is much darker than before rupture. Red blood cells color the material filling the stigma while the tertiary liquor folliculi is seen dully through the collapsed follicular wall.

Forcible rupture by pressure before the formation of the avascular area results in a tearing of the follicular wall, of the tunica albuginea, and germinal epithelium. The follicular fluid is not viscous but is very watery and squirts several feet when the wall gives away.

The few scattered cells of the corona radiata that persist after ovulation and fertilization are dispersed shortly after fertilization (figs. 55, 56, 59), but when fertilization does not follow, some corona cells persist for 17 days. The living fertilized ovum of one cell has a relatively narrow, sharply defined zona pellucida (Enders, '38). The egg proper, or vitellus, fills the zona pellucida at first, the perivitelline space appearing later. The cytoplasmic mass contains globules of lipoid material, the largest of which lie at the periphery and measure 3 micra in diameter. The globules are closely packed and are distributed more or less evenly through the cytoplasm without any tendency toward polar concentration.

As in most mammals the first polar body is formed before the ovum leaves the ovary, and the second polar body is given off after the sperm have penetrated the ovum. In ova containing both male and female pronuclei, the second polar body had been formed (figs. 44, 45).

TABLE 1

MEASUREMENTS OF LIVING MINK OVA IN MM.

Ovum	Total diameter	Diameter of cytoplasmic mass: vitellus	Thickness of zona
A	0.135×0.148	0.110	0.011
B	0.151	0.109	0.011
C	0.143	0.103	0.0113
MEASUREMENTS OF FIXED MINK OVA			
II 1A	0.144	0.123	0.009
II	0.114×0.123	0.12×0.110	0.011
III	0.123×0.152	0.12×0.120	0.010
IV	0.124×0.122	0.12×0.110	0.010

The Corpus Luteum

For a variable period after its establishment the diameter of the corpus luteum lies between 0.5 and 0.9 mm. As a general rule there is considerable variation in size of the corpora, the fewer the corpora the larger they are. Following their formation shortly after ovulation (figs. 24, 50) the corpora do not grow noticeably until the end of the breeding season (fig. 23), so the size and state of development of the corpora lutea are more closely related to the length of day than to their age. For example, in animals mated early in the season (February 26 to 28) no corpora larger than 0.8 mm. in diameter were found when the ovaries were removed 14, 16, 17, 20, or 21 days

after copulation, whereas in an animal bred March 18, from which an ovary was removed only 11 days later, the corpora were 1.1 to 1.4 mm. in diameter. In a series of animals that copulated March 18 to 22, a great increase in the size of the corpora took place some time after the tenth day following mating and before the twelfth day, or after day 8 and before day 10, figured from the time of ovulation. That much of this growth occurs rapidly is indicated by the observation that in one of these animals the corpora average 0.8 mm. in diameter in an ovary removed 11 days post-coitum and 1.3 mm. in the other ovary when it was removed 5 days later.

At the same time a great change occurs in the cytological appearance of the corpora lutea. This change always accompanies growth from the "resting" stage, during which the ova pass down the oviduct and remain clustered in the uterus, to the active stage which precedes migration and implanting of the blastocysts (figs. 26–29). In two other mink of this series mated March 18 to 22, ovaries removed 11 days post-coitum contained corpora that ranged from 0.8 to 1.2 mm. in one case and from 1.0 to 1.4 mm. in the other. In all animals of this series ovaries removed after day 11 average 1.00 mm. or larger. After this burst of rapid growth, development of the corpora is slower. At the time of implantation, which in this series took place between day 23 and 25 post-coitum, the corpora measured 1.4 to 1.8 mm., the size of the corpora corresponding roughly with the extent of implantation. The corpora maintain their size or continue to grow through pregnancy and early lactation. The largest corpus encountered, 2.2 mm., was in an animal in late pregnancy. The development of the corpus luteum is similar in pseudo-pregnancy and in pregnancy (fig. 25). Post partum the corpora change in character but persist undiminished in size for five weeks at least.

Follicles of full post-inseminal growth that fail to rupture may become, except for the enclosed ovum, typical corpora lutea (fig. 24). That they may function as such can be surmised not only from their structure but also from the cases of one-kit litters. In one such case only one follicle ruptured but the pregnancy proceeded to term with one corpus and seven unruptured follicles functioning as corpora. One corpus will not sustain a one-kit pregnancy to term. In no case was a single corpus found in a female that had delivered one kit.

Unilateral ovariectomy in early pregnancy does not cause either resorption or abortion in the mink, but in the few cases in which the remaining ovary was removed after the embryos had implanted, the embryos disappeared. If the remaining ovary is removed within about a week of parturition abortion still takes place. Apparently the ovarian secretions are essential throughout gestation and cannot be replaced by hormones of placental origin.

That the corpora lutea are inactive until the end of the breeding season is indicated by the facts, as pointed out by both Hansson ('47) and Hammond ('51*b*), that (1) histologically the corpora lutea show little sign of secretion, (2) the uterine epithelium continues in a more or less estrous condition and does not change to the progestional condition, (3) the vaginal smear remains estrous, (4) ovulation can be provoked. The fact that uterine motility increases markedly at ovulation and again just before the blastocysts migrate to their implantation sites also indicates that the corpora lutea do not begin their active role until the end of the breeding season.

Compensatory Hypertrophy

In an animal from which one ovary was removed in 1939, the remaining ovary contained 11 follicles which were either ruptured or ready to rupture when it was removed during the next breeding season. This may or may not be compensatory hypertrophy, for 11 follicles, while well above the average, may be equalled or exceeded in a single ovary of intact animals. Removal of one ovary at the height of the breeding season but before ovulation apparently results in an increase in the number of follicles matured in the remaining ovary. This was most striking in one case: 7 follicles of full pre-inseminal growth were found in one ovary of a pair on March 21. On March 27 the other ovary was removed; it contained 14 follicles of full-inseminal growth.

To judge from the few cases available, the number of kits per litter is not different in intact animals and in animals with one ovary removed. This may be attributed to compensatory hypertrophy, but the proof is inconclusive.

The Ovarian Bursa

Except for a small slit the ovarian bursa completely encloses the ovary. "This condition was known in the Mustelidae to Treverinus (1824) and Weber (1826)" (Hartman, '32: 670). This opening is somewhat smaller than the slit in the capsule of the ferret (Robinson, '18: fig. 2). Fluid injected into the bursa does not escape into the peritoneal cavity regardless of the stage

of the cycle, for the opening is blocked by the long fimbriae. In one case a fimbria projected through the slit, and in another animal that had been given diethylstilbestrol the entire ovary protruded through the slit in the capsule. The periovarian sac consists essentially of an inner and outer layer of mesothelium reinforced by a layer of dense connective tissue, the inner layer being the thicker of the two. The two layers are separated everywhere excepting at the hilus by adipose tissue. The amount of adipose tissue varies, being thickest in the fall when the animal is fat, and becoming very thin when the capsule is distended at estrus. Little adipose tissue is present at birth. The capsule is translucent when considerable fat is present between the two layers; when the capsule is distending, it is transparent because the adipose layer is much reduced in thickness. It is between these layers of mesothelium that the oviduct passes around the periovarian sac and through the inner layer, where the ostium opens into the bursa. The mucosa of the tube is continuous with the inner mesothelium of the bursa (figs. 52, 54).

During or following copulation the bursa ovarica fills slowly with fluid until the capsule is greatly distended. Immediately after prolonged copulation as much as 5 cc. of fluid has collected. In some cases at maximum distention, which occurs about the time of ovulation, the amount of fluid is so great that the ovary appears to float, suspended at the hilus, much as an embryo floats in the amniotic sac. The amount of fluid encountered varied greatly in different animals and between the two sides of the same animal. This may be a condition common in the Mustelids for Hammond and Walton ('34) refer to the variation in the amount of fluid in the capsule of the ferret. While the bursa is filling, its walls change first from a translucent to a transparent and, finally, to a well vascularized tough envelope, the increased thickness of which tends to obliterate the original two-layered condition. This vascularization starts in the region of the hilus and the ostium tubae and spreads over the capsule at such a rate that the entire capsule is vascularized in about 52 hours. Lymph channels are conspicuous in the bursa at this time.

If the capsule is slit during estrus regeneration does not take place during pregnancy or pseudopregnancy. No animals were carried over to the next breeding season to determine whether repair would take place in the longer time.

Role of Fluid in the Bursa

As has been said, after copulation the ovarian capsule slowly fills with fluid until, at ovulation, the ovary floats in the liquid. There is great motility of the parts at this time, which is probably exaggerated by the manipulation necessary to expose them. This motility was not noticed in animals in anestrum. Motility appears to reach its height between 40 and 60 hours after copulation. Observations on the mink lead to the belief that spontaneous movements, such as reported by Westman ('29) in other mammals, may cause the ovary to rotate on its hilus and cause the fimbriae tubae to "embrace" a portion of the ovary, thus bringing about a wiping action that drops the extruded ova into the infundibulum. Since the liquor folliculi is so viscous this wiping action appears to be an effective way to remove the ova from the surface of the ovary into the fimbriae.

Some investigators (Sobatta, quoted by Hartman, '39: 663), writing about the laboratory rodents, seem to think that the liquid in the ovarian capsule serves to carry the ova into the infundibulum, and that the ova remain for some time in the capsule before being carried to the infundibulum. Alden ('42) reviews this literature. On the other hand the ova may reach the ampulla by floatation, or, as has been suggested by Sobatta for the mouse, the collapse of the capsule carries the eggs into the distended ampulla. This last is unlikely in the mink for the ovarian bursa is still distended when ova have reached as far as the third loop of the uterine tube. In one case when blastocysts were in the uterus 13 days after mating the bursa was distended with fluid.

Whether or not the fluid in the capsule offers the medium through which the sperm pass to unite with the eggs or through which the eggs pass to the oviduct, the distention of the capsule tends to straighten out the loops of the tuba uterina. In one case when the capsule was distended by a cyst as well as by fluid, the tube was practically free from all bends excepting the primary long arc as it passed around the ovary.

Still other roles of the capsular fluid suggest themselves. The liquor folliculi is very viscous. In this or to this the ova are adherent. The secretion in the capsule may tend to dissolve this viscous fluid and thus release the eggs for transport by the cilia.

Origin of Capsular Fluid

The fluid which distends the capsule probably comes from the capsule in some degree, but chiefly

from the much vascularized fimbriae and ampulla rather than from the ovarian epithelium (Westman, '26, quoted from Alden, '42). The suggestion that the capsular fluid is derived at least in part from the large lymphatic vessels is supported by reports on other mammals (Andersen, '27; Wislocki and Dempsey, '39). With the small opening in the bursa blocked by the enlarged fimbriae the fluid could not come from the peritoneal cavity. In mink the abundant capsular fluid probably comes from the lymphatics.

Where Fertilization Takes Place

The entire tube and capsule of a female were removed 53 hours post-coitum and sectioned. The ovary, tube, and capsule were reconstructed from camera lucida drawings on glass plates. Four eggs were found as indicated in figure 51. All found contained male and female pronuclei so were fertilized (figs. 55, 56, 57, 58). The corona radiata is going or is gone in all. Fertilization in this case appears to have taken place either in the bursa or within the fimbriated portion of the tube, and certainly not beyond the first loop of the tuba uterina.

In another case fertilized ova were washed from the tubes 52 hours after living sperm were found in the vagina. The ova had passed the infundibular portion of the tube. These ova were 52–54 hours post-coitum and hence about 4–16 hours old (Enders, '38). At 77 hours post-coitum or 16–28 hours after ovulation a 2-celled ovum was in the second loop and an 8-celled ovum in the third loop of the oviduct (figs. 48, 49). No sperm or eggs were ever found in the capsule either by sectioning or by the careful examination of fluid withdrawn from the capsule. It would appear, therefore, that fertilization does not occur in the capsule but that it takes place in the oviduct. Two unfertilized ova were found by Hansson ('47: fig. 26) in the "mouth of the infundibulum immediately after ovulation." He observes that the egg is freed from the corona radiata in the infundibulum and that this implies that fertilization takes place here. This figure (26) shows two eggs surrounded by the cells of the cumulus oophorus. As this has never been observed in any eggs that were ovulated spontaneously, the question arises as to whether the ovulation was not speeded up by the manipulations involved in removing the tract so that the follicles were ruptured prematurely. It is of interest that even under these conditions these eggs were found in the infundibulum and not in the capsule.

If these scanty observations concerning the relationship of ovulation and transport of the ovum are correct the length of time the ova remain within the capsule in the mink is rather short. Robinson ('18) states that the contents of the ruptured follicle ". . . are carried, apparently at once, into the cranial part of the middle third of the oviduct" (p. 315). Robinson found four ova in the capsule but states that fertilization takes place in the middle third of the oviduct.

THE OVIDUCT

The oviduct is firmly attached to the ovarian capsule; it is approximately 3 cm. long. The oviduct loops back and forth over the periphery of the capsule between the outer and inner layers of the ovarian bursa, passing from the uterus along the lateral aspect of the ovary, curving around the anterior end to pass along the median aspect where it penetrates the inner layer of the ovarian capsule to open into the interior at the posterior pole of the ovary. The oviduct is not free anywhere but lies bound between the two layers of fascia which form the ovarian bursa (figs. 32, 33, 34, 49, 52, 53, 54).

The ostium tubae is surrounded by long fimbriae, the longest of which are about 7 mm. Only a few fimbriae adhere to the inner layer of the capsule, the remainder being free within the capsule. The closure of the slit in the periovarian sac is a function of the free fimbriae. Hansson ('47: 31) says that "the fimbriae in particular are very slightly developed" and refers to Westman's statement ('29) that there is probably a negative correlation between a well developed ovarian bursa and the development of the fimbriae. Since this is a comparative statement it is difficult to evaluate. The fimbriae of a mink in estrus appear to be very well developed considering the size of the animal for during estrus the fimbriae share in the general increase in size and vascularity (figs. 48, 49, 50). The blood vessels increase in size and lymph channels are large and abundant, quite in contrast to the inconspicuousness of these vessels during anestrum. The fimbriae are covered by a simple cuboidal epithelium with large nuclei centrally placed. Cilia are present.

In his account of the anatomy of the tuba uterina, Hansson ('47: 32) points out that the tunica muscularis consists of two layers, an outer longitudinal and an inner circular, the longitudinal layer being the better developed in the infundibular and ampullary segments and the circular layer strikingly developed in the isthmus. As in most

mammals the lining of the lumen of the uterine tube is not smooth but is thrown into complex folds. This lining is mostly columnar epithelium; the nuclei are oval and basal. As estrus approaches the tube increases in size and the folds become more rounded, although they still retain their polyp-like appearance when seen in cross section. The vascularization of the tube is most marked in the infundibular portions of the tube with less vascularization in the isthmus and the uterus. Cilia are present throughout the tube but are reduced in number as the uterus is approached. Only a few scattered cilia are found in the isthmus.

Passage of Ova through Tube

No direct evidence of the length of time required for the ova to pass through the tube was found. Hansson ('47: 54) discovered ova in the tuba uterina 3, 3, 3, 3½, 3½, 4, 5, 5, 6, 6, and 7 days after copulation. These ranged from 2–4 blastomeres to 8–32. On the eighth day after copulation only blastulae were found, in the tubes in 2 cases and in the uterus in another. This indicates, if one accepts the statement that ovulation follows copulation by 48 hours, that the eggs traverse the tube in 6 days. Hansson believes that ovulation in his mink followed copulation by 36 hours so he says that passage through the first half of the tube takes 12 hours but passage along the last half is at the rate of 0.04 mm. per hour. Thus the time spent in the last half of the tube by his reckoning is 6–7 days. We found ova entering the tube at the first proximal loop 52 hours post-coitum (fig. 47). Two-celled ova were recovered from the second proximal loop and 8-celled ova from the third proximal loop at 77 hours post-coitum. Eight-celled ova were recovered 5 days post-coitum in the fourth, fifth, and sixth proximal loops of the tuba uterina.

Tying off of the proximal loop of the uterine tubes at 53 to 96 hours post-coitum did not interfere with the passage of ova down the tube, as proved by gestation following this operation. If 48 hours is accepted as the approximate time interval between copulation and ovulation, this indicates that the ova reach the oviduct shortly after ovulation and pass into the second or third loop. Hansson ('47: 60) says that it is more to assume that the slow passage of the eggs down the latter half of the tube is due to the presence of a uterotubal sphincter under hormonal control than to ascribe it to ciliary or muscular transport. It is possible that such a sphincter might not interfere with the passage of fluid but might prevent an egg from passing into the uterus. However, the motility of the reproductive tract decreases greatly 12 hours after ovulation. It is possible that the high initial moltility, as well as the greater number of cilia lining the anterior portion of the tract, is responsible for the rapid transport along this portion of the tube while with decreasing motility transport slows up.

One exception must be noted: a female mated on March 3; 12 days later the oviduct and uterine horn were removed. A blastocyst, normal as far as it was possible to judge, was found among the fimbriae, and another in the uterus. Although it may be normal for fertilization to occur in the proximal end of the oviduct (figs. 51, 52, 53), the presence of a blastocyst there is surprising. Was it trapped by the fimbriae or did it move there during mating or manipulations accompanying the operation? Also, it is interesting to note that if this blastocyst was trapped there it was able to develop outside of the uterus and at the same rate as one in the usual place.

Tubo-uterine Junction

The tubes enter the uterus somewhat obliquely at approximately right angles to and posterior to the apex of the uterine cornu. The tubal ostium is circumscribed by a simple fold which projects into a pocket formed in the uterine wall. Because the tubal projection lies within this pocket no elevation is formed within the uterus. Although some circular muscle is present in the fold it is not well developed.

Fluid may be forced from the uterus into the tube or from the tube into the uterus during any part of the cycle. Very little pressure is required, indicating that little or no obstruction is offered to the passage of fluid in either direction. This differs from the condition found in other carnivores such as the cat, dog, lion (Lee, '28), and fox, but is similar to the findings in the marten, which is the only other mustelid we have examined in this manner.

Because of the ease with which fluid passed the tubo-uterine junction, and because the development of the musculature is weak, apparently it is not the tubo-uterine junction that is responsible for the retention of the fluid that distends the capsule during the pre-ovulatory and later distention. These findings do not agree altogether with those of Hansson (*loc. cit.*, 32). He refers to the opening of the tube into the uterus as a papilla. We do not find the opening guarded by a strong circular muscle forming a uterotubal splinter.

THE UTERUS

The uterus of the mink is a true uterus bicornis (figs. 32, 34). In the resting stage the uterine horns of the non-parous mink are thread-like, slightly curved structures approximately 3 cm. in length, but in the resting stage the uterus of the parous mink is considerably thicker (fig. 65) and about 1 cm. longer. The corpus uteri is approximately one third the length of the horn, being about 1.5 cm. long and 0.7 cm. in diameter. While the cornua are round in cross section, the corpus is dorso-ventrally compressed; the flattening is more marked in the anterior or fundic quarter than in the posterior portions. A median shallow groove appears on the dorsal and ventral surface at the anterior end of the corpus, and disappears as the lateral expansion lessens and the corpus becomes rounder. Glands extend even into the portion of the uterus that lies anterior to the tubo-uterine junction.

In the anestrus animal the cervical segment of the corpus uteri is straight. The infravaginal segment is a well developed protuberance lying in the same axis as the cervical segment and the vagina. The external orifice of the cervix is a transverse slit (fig. 36). There is little difference between the length of the dorsal and ventral lips of the cervix, but the ventral fornix is far deeper than the dorsal. Moreover, a transverse fold of the vaginal wall covers much of the dorsal lip. The cervical canal is straight and simple. Striking changes occur in this region during estrus and pregnancy. As estrus approaches, both dorsal and ventral fornices deepen and the infravaginal segment which protruded straight into the vagina is now strongly flexed so this canal is bent at right angles to the anterior-posterior axis, and the opening of the cervix is directed ventrally instead of posteriorly. The transverse fold in the vaginal wall that encases the dorsal half of the cervix in anestrum persists and enlarges, aiding possibly in directing the cervix ventrally, but the fold no longer covers any portion of the os cervix.

Both the dorsal and ventral fornices deepen, but the dorsal fornix deepens less and is still guarded by the above-mentioned fold. Apparently the penis tends to enter the ventral fornix during copulation. Certainly a glass rod passed into the vagina tends to enter this portion of the vagina.

As the breeding season approaches, the uterus elongates and the wall thickens (fig. 66). This increase continues to such an extent that at the time of migration of the blastocysts the uterus is so much elongated that the horns are no longer straight but are contorted into as many as four loops. The weight is, of course, much increased at this time (fig. 34).

Still further changes occur at and following parturition, most noticeable of which are the straightening out of the cervical canal, the increasing thickness of the dorsal wall of the vagina in the post-cervical region, and the obliteration of the deeper transverse folds of the vaginal wall (fig. 36).

Intra- and Transuterine Migration

Ovulation from one of a pair of ovaries in an intact animal usually, but not always, results in the equal distribution of embryos in both horns of the uterus. In cases in which one ovary with the corresponding tube and the proximal portion of the uterine horn had been removed during a previous breeding season, transuterine migration of ova took place. Nor did ablation of an ovary and tube a few days before copulation affect the migration of ova, for in one such case two kits were found implanted in the left horn and three kits in the right horn of an animal from which an ovary and tube had been removed. In these cases the ova must have been shunted through one horn to the other instead of reaching the other horn by external migration, because the operations were performed in such a manner as to seal the proximal end of the uterus, and the ovarian capsule is effectively closed, so external migration is unlikely under any circumstances. No embryos implant in the corpus uteri.

Eleven days after copulation blastocysts of 4, 9, 50, 57, 64, and 279 cells were recovered from the anterior portion of a uterine horn, the 4- and 9-celled blastocysts showing no signs of deterioration or abnormality. In a uterus removed 15 days after copulation blastocysts of 50 and 87 cells as well as blastocysts of 175 and 280 cells were associated together. In these two cases the animals were mated fairly late in the season (March 21).

Seventeen days after copulation, in mink bred early in the season, the blastocysts are still clustered in the cranial portion of the uterus. In the marten, blastocysts are in the same region 4–5 months after ovulation and in the fisher approximately 9–10 months. The time of these migrations is dependent on the increasing length of day, and implantation follows soon after migration. If the uterine musculature is responsible for the spacing of embryos, it is possible that the stimulus that prepares the uterine mucosa for implantation also

stimulates this motility. Growth may play a more important role than myometrial motility in spacing blastocysts for they do not move out of the anterior portion of the uterine horn during or following the increased motility induced by later copulation and ovulation. Although increase in length may be enough to explain some of the spacing of ova in a horn it cannot explain transuterine migration.

With the lengthening days of spring the follicles begin to grow but as the breeding season passes follicular activity drops. Is it the withdrawal of estrogen that brings about first the increased uterine motility and progestational proliferation that follows the migration of the blastocysts? Is it the withdrawal of estrogen that permits the corpora to begin to develop at this time (figs. 30, 31, 34, 66)? Nevertheless, uterine motility drops after ovulation and remains at a low level unless another ovulation follows. With lengthening days of spring the pituitary appears to be stimulated to activity and one of the initial results of this secretory activity is the lengthening of the uterine horns and the migration of the blastocysts. The pituitary acts at the same time on the corpus luteum but there is a lag before the corpus responds with increased secretion. It is during this lag that the blastocysts are moved about and thereby effectively spaced in the uterus. After a period of motility under the stimulus of the pituitary the increasing secretion of the corpus luteum exerts its influence on the uterus which responds first with decreasing motility, then sluggishness, accompanied by progestational proliferation, and finally implantation (figs. 67, 68). Certainly the blastocysts do not scatter or migrate for days in the early-bred mink and for months in the marten, yet effective spacing takes place before implantation in both. And in both it is the increasing length of day that leads to implantation. It is likely, therefore, that the migration-implantation sequence may be under the control of the pituitary, the single gland being as effective in this dual, somewhat antagonistic role, as it is in the formation of FSH and then LH, but in this case acting directly on the uterus first and then through the corpora lutea, or by making the uterus more responsive to the secretion of the corpora. It may be that, as in the experimental rabbit, the progestational reactions can be inhibited by estrogens, and that migration and implantation are delayed by the production of estrogens by the still-developing follicles. Therefore, the role played by the continuing production of estrogen must not be overlooked. Pregnant or not, the lengthening day finally puts an end to the development of large follicles in which estrogen could be produced. Few mink (3 per cent) will copulate within 10 days of migration-implantation, which may be a further indication that the estrogen level is dropping at this time. While this withdrawal of estrogen may be the direct cause of the changes that lead to migration and implantation, it is unlikely that it alone is responsible, for in the marten and fisher, migration and implantation occur when growing follicles are practically absent from the ovary. Implantation in both mink and marten is brought about by the activation of the corpora lutea as the days lengthen, but such a definite statement concerning migration of the blastocysts is not possible.

THE BLASTOCYST

Blastocysts recovered from the anterior portion of the uterine horns contain roughly up to 300 cells (figs. 60, 61, 62, 64). From cell counts of a number of blastocysts that had not migrated from the anterior portion of the uterine horns, it appears that cell division slows or stops before the 300 cell stage is reached and the blastocyst "rests" until implantation. The inner cell mass is made up of 28 to 164 cells. The inner cell mass of the mink during the delay before implantation contains more cells than that of the badger (50 cells) (Hamlett, '32), about the same number as the weasel (147) (Wright, '42*a*), fewer than the marten (350) and notably fewer than the fisher (800) (Enders and Pearson, '43*b*).

Rapid growth of the blastocysts takes place during or shortly after dispersal from their resting place in the anterior portion of the uterine horns. Migration and accelerated development occur with a period of 3 days. In one animal unimplanted blastocysts were recovered on April 11, 20 days post-coitum, while 3 days later blastocysts with the embryonic disc organized and entoderm splitting off, yet with the zona pellucida still present, were in the intact horn. The same conditions were found in an animal which mated the same day as the mink mentioned above, when the second horn was removed 4 days after the first operation. However, there was some difference in development, for in the third-day experiment nothing could be seen in the uterus by transillumination, but pale spheres were seen in the case in which 4 days elapsed. In both cases the location of the blastocysts could be seen macroscopically (2.6 mm.). In still another animal which had blastocysts at the resting stage 19 days post-coitum, the remaining blastocysts showed definite signs of

implantation 4 days later. The zona pellucida was going or gone and the uterus measured 4.0 mm. in diameter. The corpora lutea were larger than in the other animal similarly treated but showed less development. Later stages—6 days and 7 days between operations—showed progressively greater development (fig. 63) with implantation well along although the zona was not entirely gone. All the animals used in this series of experiments were bred on the twentieth or twenty-second of March, and the time of migration-implantation was remarkably uniform considering the variation of these phenomena in the mink.

All blastocysts in one horn do not develop at a uniform rate. When the range is from 279 down to 9 and 4 it is probable that the two small ones would not implant. In one horn removed 11 days after breeding blastocysts of 230, 211, 219, 251, 194, 172, 173, 144 cells were found and a uterine horn removed 13 days post-coitum held blastocysts of 274, 266, 220, 196, 190 and 62 cells. Cell counts in other uteri ran from 280 to 50 and 279 to 9 and 4. The greatest number of cells in one unimplanted blastocyst was 491.

Implantation

The blastocyst of the mink is surrounded by a well defined zona pellucida; before implantation this must be resorbed. Hartman ('39: 680) quotes Hall as finding that the zona disappears in a medium of low acidity. Hartman then says,

> Since estrin brings about a favorable condition in the uterus in this respect [low acidity] it is reasonable to suppose that when the blastocyst begins to grow by the imbibition of fluid the uterine contents are favorable for the resorption of the zona pellucida through the action of ovarian hormones.

Why pH should drop in the uterus of the mink at this time is not clear, for the estrogen level appears to be dropping as the time for implantation approaches. Apparently no action of estrogens is needed to bring about resorption of the zona in the marten or fisher, for in these mammals the blastocysts remain unimplanted while the ovary becomes quiescent, and finally implant when follicle formation is at a low ebb. Since it is the stimulation that comes with lengthening day that appears to govern implantation (Pearson and Enders, '44) it would seem that the pituitary is the responsible organ.

Blastocysts were removed and cultured (Enders and Pearson '46). The zona pellucida could not be dissolved by dropping the pH below 3.

THE VAGINA

The vagina of the mink is conspicuously long, distensible, and muscular. The length from the vestibule to the cervix averages about 3.4 cm. The mucosa is thrown into low longitudinal folds that become well marked as they approach the anterior portion of the vagina, then disappear before the cervical segment is reached. These folds are everywhere easily obliterated by distention of the organ. Transverse folds are also present, becoming more conspicuous as the longitudinal folds disappear as the cervix is approached. The strongly developed transverse fold across the dorsal wall of the vagina immediately posterior to the cervix has been mentioned. Several smaller transverse folds are present posterior to this fold, but longitudinal folds are absent from the cervical segment.

The anterior portion of the vagina appears to lengthen as estrus approaches. Transverse folds increase in number and in height; the walls of the fornices are deeply folded. The growth may be carried to such a point that the vaginal canal changes from a more or less straight tube to the shape of a recumbent S (fig. 36).

Surrounding the cervical segment of the vaginal canal is a band of circular muscle which, as estrus approaches, is strongly developed. While the edges, anterior and posterior, are not sharply defined, the mass is so large that it cannot be overlooked. Dorsally this mass appears to be very large; this is due in part to the marked thickening of the entire dorsal wall of the vagina at this time as well as to the hypertrophy of the muscular band. In the intact animal this portion of the vagina is capable of considerable distention and even trauma without rupture.

The Cycle in the Vagina

While the differences between the anestrous vaginal smear and the other stages of the estrous cycle are clear, the classification of the various stages of proestrum and estrus is very difficult. No clear-cut point appears between proestrum and estrus because Hansson (*loc. cit.*, 100) says the changes take place very slowly. Nor does copulation permanently affect the alternation or persistence of the several types of smear that occur from the onset of proestrum (fig. 40). Hansson ('47: 99–100) summarizes his work on the vaginal smear in mink by saying that changes in the smear "conform entirely with conditions in other animals up to estrus."

In anestrum the vaginal epithelium is stratified as in the ferret (Hamilton and Gould, '40). The basal zone is columnar and the superficial zone is composed of several layers (2–7) of rounded cells (figs. 38, 39). Cells found in the vaginal smear at this time are few; they are typically large, nucleated, and somewhat more squamous than a study of cross sections of the vagina might indicate. The explanation of the more squamous appearance may be found by examination of serial sections, since these show that, while most of the cells lining the lumen are rounded, there are patches where squamous cells are abundant. It is probably these areas where local desquamation is taking place that contribute the squamous cells found in the anestrous smear. The distribution of squamous areas follows no pattern, nor is any significant difference detectable between virgin and parous females (fig. 37).

With the approach of proestrum increasing numbers of squamous areas appear. The basal zone is still columnar; the number of layers of rounded cells is decreased in rough proportion to the increase in the number of layers of squamous cells. In a typical section in the later stage of proestrum, the columnar cells appear to round up, thus obscuring the division between the basal zone and the rounded cells. These two zones are 3–4 cells deep, irregularly arranged, and there is considerable variation in the relationship of the depth of the two zones to each other. A third zone now appears which is composed of flattened cells. In cross section this luminal zone may be 4 layers deep; the nuclei are scattered and in some cases are disappearing. Cornification starts in this third or luminal zone and desquamation of this zone increases as estrus approaches. The vaginal smear reflects these changes, for the rounded cells increase in abundance until the day before copulation, at which time the smear appears to consist almost entirely of these cells. Closer inspection, however, reveals about 10 cornified cells to 100 round cells. The beginnings of cornification are observable in from 10 to 20 per cent of the rounded cells. Actually the "rounded cells" are only comparatively rounded and are so-called chiefly to distinguish them from the cornified cells with more angular outlines. The stage described above corresponds, to judge from their illustrations, to Stage I of estrus in the ferret as described by Hamilton and Gould. Copulation may take place during this stage but usually does not until the next stage is reached.

Marked cornification of the vagina now follows. The rounded cells begin to disappear from the smear and the ratio of rounded to cornified cells is reversed, while in cross sections strands or sheets of desquamated epithelial cells are seen to break away from the vaginal wall. The thickness of the desquamating zone varies considerably, being deeper in the recesses of the vaginal folds than elsewhere. The nuclei of the squamous cells have all but disintegrated. This is probably Stage II of Hamilton and Gould.

Vaginal smears taken from 27 females immediately following their first copulation show that cornified cells outnumber other types. Twenty per cent of the cells may be rounded but this high percentage was found in a single case. No smears had been made of these females previous to the post-coital smear; hence their high degree of cornification was not due to previous mechanical stimulation. These mink were in a herd where they were exposed to males daily or every other day until they bred and were therefore free to breed as soon as they were receptive. It seems, therefore, that if one must designate one type of smear as the estrous smear, the smear containing a high proportion of cornified cells and lacking leucocytes should be so labeled. It is very possible that the high percentage of cornified cells appearing in these post-coital smears was the result of freeing the cells from the wall of the vagina, particularly the squamous patches which are always present during the breeding season, by the mechanical action of the penis. On the other hand this type of smear appears in isolated females as well as in females that have bred, so while some of the cornified cells may have been detached by mechanical action during copulation, the percentage of cornified cells is not changed thereby.

Following copulation ragged cornified cells are present and leucocytes appear in numbers. If copulation occurs at the end of the breeding season, the leucocytes may diminish in number to the vanishing point after being present for a day or two, and then increase in number until a condition similar to anestrum is established. On the other hand the smear typical of proestrum follows if copulation occurs before the end of the season. Hundreds of post-coital smears taken from many herds and from animals in our own colony bear out these findings. This appears to disagree with Hansson ('47: 100), who finds that only partial desquamation and no invasion by leucocytes follows ovulation. In fact, the smear he describes as post-ovulatory appears in our material to be

the estrous smear. This apparent difference of opinion arises, probably, in the use of such terms as "partial desquamation" for the post-ovulatory stage. Hansson is entirely correct in saying (p. 100) that no metestrous stage is found in mink during the breeding season.

Elongate connective tissue cells from the vaginal wall below the epithelial layers find their way into vaginal smears from late proestrum on. These cells are easily recognized but do not appear to bear any relation to the cycle.

Throughout this description of the vaginal cycle a more or less idealized picture has been presented. In only a few cases are the stages as clear cut as described. Only four points can be recognized with any clarity: (1) anestrum, (2) proestrum, (3) the day the female copulates, and (4) the post-coital smear with massive desquamated cornified cells and leucocytes. The length of each of the two middle periods varies and the succession of alternation of proestrum and estrus, or between Stage I and Stage II of estrus within the breeding period, is obscure.

The number of times the cornified cell type smear appears in the same unbred female during a breeding season is variable. It must also be recorded that a female may not breed even though the vaginal smear is of this so-called estrous type.

The difficulties releated in determining the exact relationship between the various types of vaginal smears during proestrum and estrus are probably inherent in an animal which does not ovulate spontaneously and which does not maintain, without fluctuation, the thickened cornified vaginal epithelium, usually diagnostic of estrus, until either breeding takes place or until termination of the breeding season. In this respect the mink and marten appear to be somewhat unique, although this condition is suspected in some wild rabbits. Another complicating factor is that copulation in the mink, whether resulting in pregnancy, pseudo-pregnancy, ovulation, or no ovulation, appears to alter the course of the vaginal cycle only to the extent of producing a temporary post-copulatory increase in the number of leucocytes present in the smear. When this phase is passed there is no way short of laparotomy of determining whether the female has or has not bred, for the vaginal smear returns to the proestrous or estrous type and the vulva maintains its size. Apparently only the cessation of ovarian activity and the ending of the breeding season restore the anestrus smear.

What factors control this cyclic pattern? A study of the ovarian cycle offers some light. It is generally conceded that the presence of estrogen accounts for the thickened vaginal epithelium associated with estrus. Hansson (p. 100) believes that this is the case in mink. He also suggests that the increase in the size of the ovarian follicles that follows copulation increases the amount of estrogen and that this increase in estrogen, followed by a fall when the follicles rupture, results in desquamation. Experimentally this epithelium can be maintained by injection. "Such extensive experimental estrus periods simulate those which sometimes occur in non-spontaneously ovulating normal animals . . . when mating stimuli are withheld" (Allen *et al.*, '39: 472). Under the discussion of the cycle in the ovary it is pointed out that, to judge from the size and number of the follicles in the ovary, the production of estrogen occurs throughout the breeding season, and in waves rather than in constant amounts. Unfortunately there is no clear-cut evidence to prove that with the development of follicles of full pre-inseminal growth cornified cells predominate in the vaginal smear, and that with their waning the smear returns to the proestrous condition. This may be because the waves of follicles overlap and, while each wave affects the amount of cornification, overlapping obscures the cycle in the vagina. It should be recalled in this connection that the swelling of the vulva, which is dependent upon the production of estrogen, is more or less constant throughout the breeding season, and also that the cornification of the vaginal epithelium is a more sensitive test for estrogen than vulvar swelling. Short-time fluctuations might therefore be reflected by changes in the vagina without affecting the vulva.

Like cornification, the condition and the amount of mucus present are variable. Mucus varies from a heavy, stringy, scanty condition, usually encountered in late February or early March, to the comparatively abundant fluid found in late March and in early April. The amount and kind of mucus may vary from day to day. No particular phase of proestrum or estrus is associated with fluid mucus, but in general when heavy viscous mucus is present the animal is reluctant to breed.

What follicular conditions exist in the ovary at the height of cornification? In most ovaries follicles of full pre-inseminal growth are present when copulation first takes place, unless this occurs too early in the breeding season for such follicles to be developed (figs. 11, 12). At no

time, not even during pregnancy, is all follicular growth inhibited, so it is not surprising that one or more waves of follicles might develop between copulation and the close of the breeding season (figs. 30, 31). Correlated with the development of large follicles there may be a fluctuation in the number of cornified cells suggesting another estrus. Where large follicles develop after ovulation the percentage of cornified cells tends to drop, then rises again. Such smears may be recognized, moreover, by the presence of leucocytes.

Since corpora lutea do not develop until 48 hours or longer post-coitum, in rare cases another set of follicles may approach the stage of full preinseminal growth before the corpora inhibit follicular growth. To the fact that some follicles continue to develop throughout the breeding season may be attributed the apparent reappearance of the proestrous type of vaginal smear even after large numbers of cornified cells have appeared, copulation has taken place, and the animal has become pregnant, as proved by bearing a litter.

At one time, in a limited number of animals, there was some indication that pregnancy could be detected by the vesiculated and vacuolated appearance of the cytoplasm of the nucleated epithelial cells in the vaginal smear. Extensive check, however, indicated that the method was not more than 80 per cent effective even when the smears were made under good conditions. In this the mink differs from the cat (Foster and Hisaw, '35) for which this method is satisfactory.

The Vulvar Cycle

As in the ferret (Marshall, '33) and the marten (Enders and Leekley, '41), the vulva of the mink is of minimal size during anestrum. With the approach of estrus the vulva increases in size, but the increase is small compared with the strikingly great increase in the ferret and marten. The swelling persists throughout the breeding season and then recedes. Some breeders report fluctuations in the size of the vulva within each breeding season, and some go so far as to report a relationship between the variation in size and receptivity. The changes referred to here may be the result of copulation rather than any fluctuation. Since the degree of swelling varies within the breeding period of the marten (Enders and Leekley, '41) the possibility of such changes cannot be ruled out in the mink. It was not observed in this study. Copulation, aside from temporary, very localized traumatic effects, does not cause the vulvar swelling to increase or lessen, nor does pregnancy appear to have any effect on the duration of the swelling. In this respect the mink differs from the ferret and is similar to the marten. The onset and recession of vulvar swelling are fairly uniform within a herd. No differences were noted in the amount or time of swelling of animals kept under usual conditions or in isolation.

Pregnant mare serum (Gonadogen) injected subcutaneously into females in November brought about a slight increase in the size of the vulva. In April, on the other hand, Hartsough ('42: 18) reports "excessive swelling and redness of the vulva" in females treated on April 8 with 1.5 cc. of a preparation of pregnant mare serum (Gonadin). Apparently the vulvar response is greater to pregnant mare serum during the breeding season than during anestrum. Although diethylstilbestrol will bring about breeding behavior in ovariectomized mink the vulva does not respond to the treatment, so intromission is impossible (Enders, '48). In intact animals there is no vulvar hypertrophy if diethylstilbestrol is injected or fed after the breeding season.

THE MALE

THE PENIS

The penis of the adult mink is approximately 5.6 cm. long and is enclosed in a sheath that is close to the ventral musculature. When the penis is slipped out of the sheath and stimulated, the engorgement of the distal third or half is very marked. The engorged tissue corresponds to the pars longa glandis and pars bulbus glandis of the dog, but the entire glans of the mink is uniformly sub-cylindrical without the conspicious external differentiation of the lateral swellings that mark off the two portions of the glans in the dog. As in many carnivores the corpora cavernosa penis unite to form the os penis. The caudal end of this bone is truncated, the bone triangular in cross section. The anterior end is curved dorsally, ending finally in a curved, hook-like end. The distal half of the ventral surface is grooved, the groove being continued around the recurved portion, terminating thereby on the dorsal surface. The urethra lies in this groove. In the resting state the glans appears to be larger at the distal end of the penis, but on erection this difference disappears and the entire glands swells until it is uniform in diameter. Also in erection the os penis protrudes beyond the glands so the external urethral orifice lies ventral and anterior to the recurved portion of the os penis.

THE ANATOMY OF COITUS

The anatomy of coitus may be visualized from the structure of the penis and vagina. The shape and size of the penis are such that it could not possibly penetrate or interlock with the cervical canal. Not only is the cervical os slit-like, but it is directed ventrally as well as guarded dorsally by a strong transverse fold of the vagina (fig. 36). How then do the sperm reach the uterus, and where is the ejaculate deposited? The powerful piston-like strokes of the penis might smear sperm over the cervix, or the rapid rise and fall in pressure in the vagina caused by these actions might force the spermatic fluid into the uterus. In this connection it should be recalled that during erection the up-curved tip of the os penis projects beyond the glans and therefore encounters the os cervix when the anterior tip of the glans penis slips into the ventral fornix. This brings the urethral orifice slightly anterior to the opening of the os cervix and at the same time brings the grooved os penis into contact with the ventral and anterior walls of the fornix, thus completing a channel from the orifice to the end of the os penis. Any discharge from the urethra would follow this channel in the os penis and be conveyed dorsally and posteriorly from the meatus to be discharged where the recurved tip of the os penis rests against the os cervix.

The mechanism just described appears to be too teleological to be plausible, but anatomical observations appear to justify its description. Regardless of the mechanism by which sperm reach the uterus, very little spermatic fluid is found in the vagina even after prolonged copulation.

There is no evidence of the locking so characteristic of dogs and foxes. From the description of the structure of the vagina and the relation of the cervix to it, one is led to believe that the penis passes into the ventral fornix. If, following the initial thrusting, the penis comes to lie in the ventral fornix, the circumvaginal band which surrounds the vagina in this region might by contraction lock the penis in the canal even in the absence of the lateral swellings of the glans. However, a disturbance of sufficient magnitude at any time during intromission will cause the male to release his grip on the neck of the female and to withdraw, indicating that copulation can be broken at any time. Taking advantage of this absence of locking some breeders make a practice of separating copulation mink at the end of 15 minutes to conserve the male.

EJACULATION

Possibly the normal discharge of the ejaculate is more of a dribble than an explosive ejaculation. Electric stimulation of the mink by means of a technique highly successful with rats and successful with foxes (Benham and Enders, '41) resulted in no visible discharge of spermatic fluid or else a very small discharge. The material recovered from the meatus following stimulation was scanty and contained a high concentration of sperm indicating that very little discharge from accessory organs was taking place. It should be recalled in this connection that following copulation very little spermatic fluid is found in the vagina, indicating that the volume of the ejaculate is not large.

Cases in which pregnancy has resulted from a single copulation with intromission of less than 3 minutes are not rare, which suggests that there may be swift, initial ejaculation at or shortly after intromission or that even a short period of "dribble" is sufficient to impregnate.

Difficulties in determining the moment of ejaculation prohibited accurate methods of determining the rate of passage of the sperm. Sperm were recovered at the tubo-uterine junction within 15 minutes of the beginning of copulation. However, sperm were not recovered from the uterine tubes nor the ovarian bursa at this time, and this failure was first ascribed to faulty technique rather than to absence of sperm. Two hours post-coitum, sperm were plentiful at the junction, but none were found beyond this point. Because of the increasing amount of fluid in the bursa it is possible that failure to find sperm was due to dispersal through the large volume of liquid, but the failure to find them in the tubes is unexplained. Forty-eight hours post-coitum live sperm were found in abundance in the proximal half of the uterus and in the oviduct. But the greatest concentration of sperm was in the ampulla.

Uterine fistulas were made but no females so treated ever copulated. Hence any observation on the type of ejaculate is indirect. Judging from behavior and breeding records, the first ejaculate, whether explosive or dribble, accompanies a series of copulatory thrusts which follow intromission. Since there may be several series of activity, each followed by a period of rest, it is possible that several distinct series of ejaculations take place when coitus is prolonged.

Active males can copulate as many as fifty times during a breeding season of 40 days, but this

is unusual. However, two cases are worthy of note. One male, a silver sable mutation, bred by David W. Henderson, copulated 44 times between March 2 and April 16. This is a very long season and it should be pointed out that copulation after April 3 did not produce litters, but whether this was the fault of the male or the female was not determined. Of the 44 copulations at least 10 failed to produce litters. Other copulations may have been sterile too, but because the female bred twice the results were masked. This male copulated 44 times with 39 females and sired 123 kits in 29 litters.

Even more remarkable is the record of a male owned by H. B. Walters. This animal sired 197 kits out of 56 females. He copulated 61 times during the breeding season which extended from March 1 to April 11. All matings were broken up by the attendant as soon as he judged that ejaculation had occurred. The shortest mating lasted 2 minutes and the longest about 35 minutes. As many as 5 matings were permitted in one day. Dr. Walters gave this male about 1 cc. of ascorbic acid per day for about 25 to 30 days but does not know what effect, if any, this had on the breeding record.

Some skilled husbandmen believe that the capacity of the male depends on the skillful selection of receptive females by the breeder and that records such as the two given above could be the usual ones. However, the majority of mink breeders look upon such records as fantastic because they cannot secure any such performance, so usually keep one male to every 3 to 7 females. We have found that males differ greatly in breeding potential, a few being unwilling to breed at any time whereas others are vigorous and aggressive over a period of weeks but we have not kept enough females to utilize the full capacity of such males as the two described.

SURVIVAL OF SPERM

Sperm persist in the glands of the uterus for more than 17 days post-coitum. They may be sufficiently abundant to give the cells of the glands the appearance of being ciliated even though there is no real orientation of the sperm to the gland cells.

Since ovulation follows copulation, sperm survive in the female genital tract and retain their power to fertilize for at least 48 hours. The higher percentage of pregnancies and larger number of kits that follow breeding on two successive days as compared with a single mating are due rather to the increased stimulus, as in multiple matings in the rat, rather than to fresher sperm at ovulation. This view is based on the higher percentage of pregnancies following successive matings and not on the larger number of kits. It can, of course, be argued that the increased number of kits points to better fertilization but, after watching mink mate and studying the stimulus necessary for ovulation and pregnancy, the first explanation seems to be the correct one and it appears that survival of sperm is not involved. Just how long sperm do retain their ability to fertilize was not determined. In a female examined 48 hours after insemination sperm in the ampulla were moving rapidly. In fact, their motility was the greatest even seen. Moreover, they appeared to be moving in a straight path. No dead ones were found. Sperm ejaculated at the same time but found in the uterus were far less motile and many were dead.

ARTIFICIAL INSEMINATION

Successful insemination has been reported personally by two ranchers. Many have tried it without success. Moyle ('50: 10) transferred semen from the vagina after normal copulation to unbred females and then bred these females to vasectomized males. Two of 3 females so treated produced kits. In another experiment Moyle bred a female to an Aleutian male and following copulation inseminated her with semen from an Arctic male. Of the 5 kits she bore, one was sired by the Arctic male. Spencer ('51), using 4 females that had been exposed and caught by males but not bred and 2 females that had refused to breed, secured 5 litters. He recommends drawing semen from the cervix of a naturally mated female and depositing it at the cervix. There is no intimation as to whether the semen was deposited in the os. The problem of securing semen is serious. Semen withdrawn from the vagina is usually contaminated with urine for the mink urinates on being picked up and may continue to urinate while the pipette is being withdrawn. One rancher reported that he has a male from which he could secure semen by manual manipulation. We used an electric stimulator with indifferent success.

ACTIVITY

Some indication of the physical activity can be obtained from the use of an exercise wheel. A male placed in a large cage from which he could climb into an exercise wheel was traveling as much as 20 miles in 24 hours in April. Unfortunately

records were not obtained when the breeding season was at its height, nor were they obtained from the more active males. The amount of activity tapers off after mid-April, but the animals were never lethargic.

Marshall's ('36) study of mink in the field gives tables covering activity of males and females from December through the middle of April, correlating activity with temperature and other data. He notes "extended movements of the males" during the mating season (p. 388), and greater activity of the males than of the females (p. 383). While the method Marshall employed in determining sex from the measurement of tracks of the hind feet must be used with caution (Sealander, '44), observations in caged colonies indicate that males tend to be more easily aroused and, over a period of time, to be more active. Although periods of brief, intense activity are characteristic of females at this season, their total activity is not so great as that of the males.

THE BREEDING CYCLE

The majority of litters arrive early in May. The kits grow with great rapidity during the first 8 weeks, then more slowly, attaining sub-adult size by the end of November. Mink are sexually mature by February or March at approximately 10 months of age.

Females are fecund for 7 years or more. One female was alive and bearing at 11 years of age (Mercer, '40). She had borne 58 kits during her lifetime.

Although the annual breeding cycle of the mink is unique in some respects, it resembles in other respects the annual cycle of mammals of several orders. The definite, short period of estrus during which copulation results in ovulation is found in the cat. The cat may come into heat several times a year; moreover, each period of estrus is much shorter than that in the mink. The marten resembles the mink in much of its breeding behavior: i.e. there is a period of several weeks during which copulation takes place (Enders and Leekley, '41). Gestation is long (Ashbrook and Hanson, '27; Pearson and Enders, '44) so there is a corresponding shortening of the anestrous period. In the ferret, in the absence of breeding, estrus lasts for months, in this respect resembling the rabbit. The cycle of the mink, therefore, lies between the short estrus of the cat and the long estrus of the ferret. Probably the type of cycle is not unique, for field studies of several mustelids point to similar cycles (Pearson and Enders, '44).

DURATION OF ESTRUS AND ANESTRUM

Estrus in the mink occurs but once each year and is comparatively short. The date of onset of estrus varies with the "type" or sub-species, and varies within each group of the same sub-species from year to year. Late February, March, and the first week in April are usually considered the breeding season because it is during this period that the animals will copulate. During a typical season the earliest copulation reported at the U. S. Fur Farm was February 25 and the latest was April 9. The individual mink is not in estrus throughout this extended period. Fur-farm practice is to place each female with a male several times during each season, since the only sign of heat that most breeders recognize is the willingness to breed. Because of the difficulty of determining when a female is in estrus, the length of the period in the individual is difficult to determine. Once she enters estrus she remains in that state until her season is over; that is, copulation, ovulation, or pregnancy does not appear to shorten markedly the period of estrus, nor does lack of copulation or ovulation lengthen the period. In many females the period in which she will copulate is about 3 weeks, but variations are great, being longer in some, shorter in others. Anestrum follows at once if no ovulation takes place. If ovulation does take place, estrus is followed by pregnancy or psuedo-pregnancy. Fur farmers have changed breeding practice strikingly since this investigation started. In 1936 the usual practice was to start breeding on or about February 20, many ranchers starting earlier or later. Present practice is to start breeding on or about March 7, some ranchers waiting until the fourteenth.

Genetic constitution appears to be a determining factor of the date of estrus. "Yukon" mink are said to breed about 2 weeks later than "Quebec" or "Eastern" mink, but individual variation is often greater than this. The role of stimulation from other animals has been discussed. Factors including food, length of day, and temperature probably affect the development of ovarian follicles, but the role played by food was not determined in this series of experiments. Other investigators have conducted experiments but report that the mink is a very unsatisfactory experimental animal.

A practice in some respects similar to "flushing" in sheep in almost standard. After the pelting season the diet is changed usually by increasing the percentage of red meat. This raises the pro-

tein content and lowers the caloric intake. This practice is entirely empirical and is based on the common observation that fat animals are not active breeders. There is no uniformity in description of what is fat, lean, or just right, so practice varies. Most breeders see to it that the animals are hungry before the next feeding for this increases their activity. It may be that it is not the composition of the diet so much as the activity that results from the lower caloric value that stimulates breeding condition.

Light plays a role in determining the onset of heat, for mink kept in very dark quarters from weaning until the normal breeding season may never come into heat. Whether these animals would come into heat and reproduce normally the next year we do not know, but we believe that they would if there were enough light. Breeders report that year-old males are particularly likely to fail as breeders if kept too much under cover. It is unlikely that this failure is due to differences in exercise since mink cages are fairly well standardized as to size. Nor is it due to diet. One breeder who kept his stock in almost total darkness found that they did not breed, so he tore off the sides and a part of the roof of his breeding shed and brought new stock: keeping the mink in the same cages and feeding the same mixture, the animals reproduced normally in the light quarters.

Recently Hammond ('51) issued a preliminary report on control of reproduction by light. He believes that the initiation of the spring breeding season of mink is a short day phenomenon, for spermatogenesis may start in December and some females show an estrous smear in early January. While an estrous smear is far from guaranteeing that a mink will mate, the fact that mink will "chuckle" and show other signs of breeding behavior as early as this is also significant.

The effect of the total hours of sunlight on the initiation of sexual activity in ranch mink has been studied by Stevenson ('46). He concludes that "the number of hours of sunlight in February does not appear to bear any relationship to the number of female mink that will mate on or before March 10th of a given year" observing that . . . "the quantity of sunlight required to elicit reproductive activity is apparently so low that sufficient is obtained in even the dullest years" (p. 142). Experiments of many mammals indicate that sunlight as sunlight is not necessarily the stimulus, for artificial illumination is as effective as sunlight provided both duration and intensity are sufficient (Bissonnette, '35; Bissonnette and Baily, '36; Bissonnette and Csech, '37; Hammond, '51).

Hansson ('47: 16) found that a higher temperature before and during the mating season leads to earlier breeding. Data from one herd in New York fail to indicate any such relationship over a period of ten years. Allen ('40: 38) quotes Douglas who "notes that mink from Labrador are apt to breed about 12 days later than the average 'Quebec' mink." Allen says that climate or temperature may be responsible "rather than difference in breed." Here again date of breeding may be a reflection of breeding practice rather than of physiology.

Although some commercial breeders are sure that 2-year-old-mink of both sexes come into heat before the young of the previous year, Stevenson's ('46) work indicates that this is not true as far as females are concerned for in some years virgin females were the first animals to breed (p. 140). Hansson ('47: 17) says that the older females mated 2 days earlier than the virgin females. While no work has been done on males there is some indication that year-old males are somewhat later in displaying breeding activity than older males. Many mink ranchers report that some males do not breed the first year. Here again generalization is dangerous for other factors, both genetic and environmental, appear to be involved, in this matter the environmental being the more important.

An interesting side-light on the role of environment on the duration of the breeding season is the common observation that if young males are shipped to a show or to another ranch a higher percentage of them breed the first year than their litter mates that are not subjected to the stimulus of shipping (Bowness, '48: 12). Some ranchers are so convinced that young males need "stirring up" that they handle them frequently even to taking them on truck rides. Also, there is some indication that when litters are broken up early the males are not so active at the beginning of their first breeding season as males from litters which stayed together longer. Records from ranches where the young males are examined frequently indicate that this results in fewer non-breeding young males but since these ranches are run by better husbandmen the role of the environment is obscured by the more skillful husbandry and more rigorous selection of breeders.

BREEDING BEHAVIOR AND COPULATION

With the approach of the breeding season the general physical activity of the animals increases, the animals "chuckle," and they are more easily excited by other animals' screaming or chuckling. Instead of screaming when picked up by the attendant, some females will chuckle and other animals, both males and females, may join in until the entire group is very much excited. Males chuckle more readily than females and normally chuckle during copulation.

Many ranchers take the female to the cage of the male for breeding (Gunn, '49: 22). This reverses, in a sense, the usual procedure in nature, in which the male enters the territory of the female. The male approaches the intruder cautiously and, if she does not run or turn to fight, smells at the genitalia. If the female remains motionless the male seldom tries to grasp her, but the moment she moves he grasps her by the skin on the back of the neck. Some receptive females give the appearance of tightening the skin of this region before the male seizes her. Apparently the long canine teeth of the male may penetrate the skin, thus affording an excellent grip. That the canines are driven through the skin is indicated by fatal cases, in which they penetrate into the brain when the male grsaps the region at the base of the skull instead of obtaining the usual cervical grip: the likelihood of accidental death is increased by resistance on the part of the female.

Copulation in the mink is often furious. It may be preceded by a "courtship" of varying length which resembles a rough and tumble fight. The male being larger and heavier utilizes these advantages to force or maneuver the female into position. After a longer or shorter struggle the male secures a firm hold on the skin of the neck immediately back of the head. If after being caught the female is reluctant to breed, she arches her back. When she does this the male applies pressure on her hips by placing his hind feet on her and treading. Provided the male maintains his grip, eventually she straightens out and intromission is accomplished. All this may take place without severe struggle, but this is the exception. If the female resists at first but elevates her tail to one side when she is caught, she will probably copulate. It is questionable whether intromission is possible without (1) cocking of the tail, (2) straightening of the back and then tilting of the pelvis, and (3) extrusion and eversion of the vulva.

After the male has seized the skin of the neck of the female and her body is straightened out and her tail cocked to one side he makes a series of pelvic thrusts. The vulva of the female is everted, the tip of the penis encounters this, and intromission is effected. Following intromission the male gives a series of strong copulatory thrusts and then the pair may roll over on their sides. At this point the female appears to have some reaction that may constitute orgasm. After this reaction most females appear to lose interest or to become passive. Prolonged copulation, which is the rule, consists of periods of activity followed by periods of rest. The male may drag the passive female about or they may rest upright or on their sides but the most characteristic activity is the repeated series of rhythmic pelvic thrusts that alternate with periods of rest. Intromission may last as long as 3 hours, a fact apparently well known to early trappers. At no time during intromission does the male release his hold on the skin of the nape although he may relax. If the female struggles and intromission is terminated the male attempts to hold on and if he is successful will gain intromission again. As soon as he loosens his grip on the skin of the neck of the female she moves away even though she had not struggled before being released. Relaxing this hold appears to be the signal for the termination of copulatory behavior. After copulation ends both male and female lick and clean themselves chiefly about the genital region and on the sides, belly, and back. In sunny weather they may turn over on their backs and relax in this position. They may or may not remain close to each other but they usually ignore each other. If another female is introduced at this point the new female draws the attention of the male.

The male may drag the female about the cage without attempting intromission or, attempting it, he is unable to achieve it; in such cases the female appears to tire of the male's efforts, breaks away, and fights. Sometimes when male and female are placed together the female may resist the male and at other times both are completely indifferent.

Some ranchers have developed ingenious methods to restrain a female that is more prone to attack a male than to copulate. These methods are used on females still unmated toward the end of the breeding season in a desperate attempt to get them to breed. Sometimes such techniques are successful. Moyle ('50: 23) taped the mouths of 11 females still unbred and exposed them to active males. Ten of these females bore litters; the litter

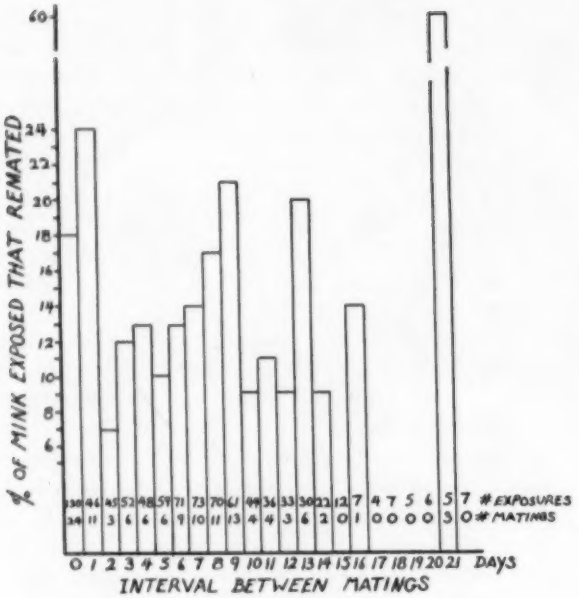


FIG. 2. Percentage of mink exposed that remated at various intervals.

average was 5.8 kits. Other breeders use whiskey and still others attempt to tire the female to the point of exhaustion either by chasing her or by placing her with one male after another until she copulates. Death from exhaustion is not uncommon when females are exposed without rest to a series of vigorous males. An experienced vigorous male is almost sure to gain intromission if he once secures the proper hold on the skin of the neck.

THE OVARIAN CYCLE

Many practical mink breeders are convinced that there are periods of greater and lesser receptivity in the individual female within the limits of the breeding season. These periods, they report, tend to run in cycles of increased receptivity at 3, 4, 5, 6, or 7 day intervals. While many breeders agree that these periods exist, they do not agree as to the length of the cycles. They point to breeding records showing that after one copulation a second copulation tends to occur a given number of days later. Since their records show only the successful copulations but not the number of exposures, it is difficult to convince them that the apparent cycle is probably due to breeding practice rather than to a cycle that exists in the female mink. Johansson ('40), speaking of this belief, recognized that "It is . . . difficult to tell in what respects the interval between copulations or cycle as expressed on the breeding chart corresponds to a biological reality or is a picture of the practice at Lido." When records of exposure as well as records of copulation are kept, no demonstrable cycle of receptivity is discernible (fig. 2). Records of frequency of certain intervals between matings also show that a large number of animals breed only once. A small peak occurs at 9 days. Johannson ('40) shows a similar peak at 8 days. However, when the percentage of exposed animals that mated is calculated, the result indicates not one but several peaks, these peaks following on the first day after, the ninth and thirteenth days, and the twenty-first day after first mating. Few animals were exposed on the thirteenth and first days, so the results are of questionable significance. This chart cannot show several of the variables that, doubtless, affect the result. In the first place, the exposure to the male followed no system. Different males were used in some cases and not in others; that is, the same male might have been placed with a female each time or several males placed with her in succession. Females may refuse several males in succession one day only to copulate with the next male offered, and males will behave similarly. There may be a change in vigor of the males as the season waxes and wanes. Possibly males may not copulate so freely with females that have bred before. Since mink ovulate after copulation, even though implantation is delayed, a majority of females would be pregnant or pseudo-pregnant before the second copulation if the interval were longer than 48 to 52 hours.

The mating record of the same animal through several seasons shows no discernible pattern as to the number of matings, although many breeders believe that a given female will breed on the same dates each year. It is concluded, therefore, that although the female mink may show increased receptivity at one or at several times during the breeding season, this behavior does not follow any set cyclic pattern. An explanation of this apparent change in receptivity may lie in the estrogen level in the blood of the female. This is discussed under the section on the ovary.

Several cases of what may be called persistent mating behavior were encountered: these animals had ovarian cysts and did not bear litters. The cysts were apparently of follicular origin. In spite of the fact that these animals bred frequently during the breeding season, apparently they came into estrus only during the normal spring period. Within this period they breed persistently, and with the ending of the season become refractory.

In only one of these animals with cystic ovaries did ovulation occur. Corpora lutea were not formed and implantation did not follow ovulation. This suggests that the secretion from the cyst may be responsible for persistent estrus and for the failure of corpora lutea to form when ovulation did occur, and that the secretion may be estrogen. In each case only one cyst was present.

MODIFICATION OF BREEDING CYCLE

"T. H. Bissonnette and Everett Wilson at Somers, Conn., found it possible, by altering daily periods of lighting, to get mink to breed and drop kits in late fall and winter. So far only a few individuals have responded satisfactorily" (Personal communication). After a few years the attempt was abandoned. Some details were published by others (Callan, '48: 15).

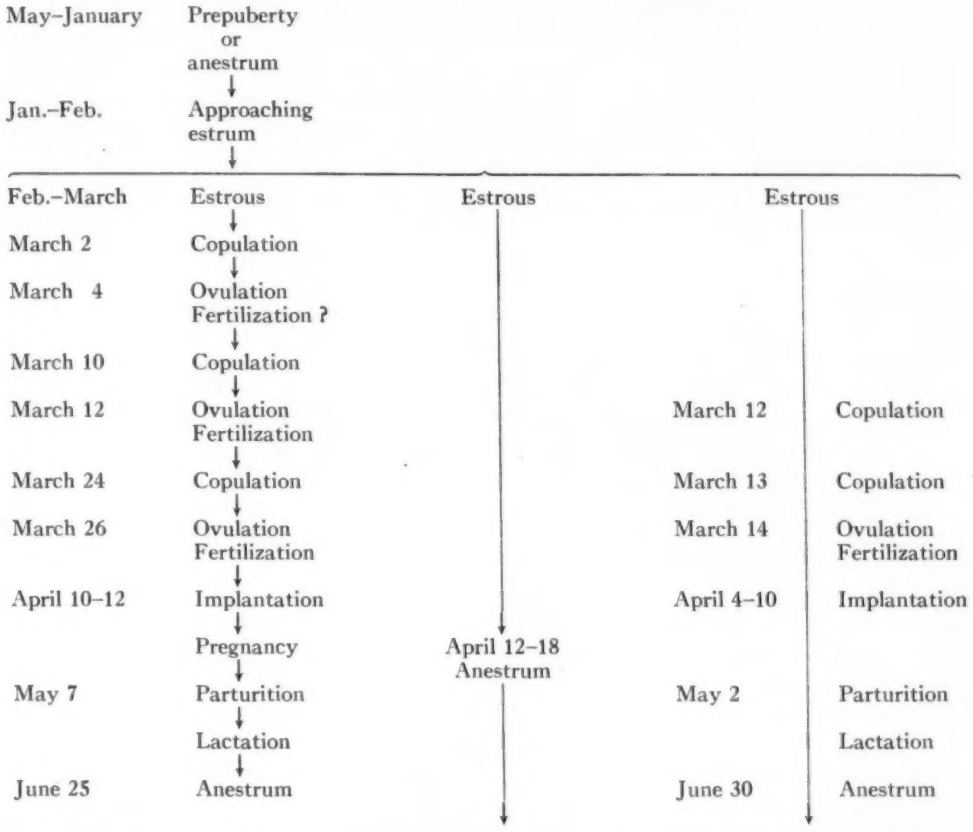
NON-BREEDING FEMALES

No breeder with more than a few mink ever succeeds in breeding all the females on his ranch. The percentage of females that do not breed approximates 10 to 30 and is, apparently, a matter of skillful handling, the more experienced men having the lowest percentage of non-breeders. However skillful the husbandry, certain animals will not breed. In 1941 all non-breeding females in our stock were killed on April 14 and the ovaries and pituitary removed. In one case the ovary was cystic, two had ovulated without copulating, in three the ovaries were inactive, being indistinguishable from those of anestrous animals, five pairs of ovaries contained atretic follicles only. The uteri of the animals with atretic follicles were small and inactive; apparently atresia took place early in the breeding season before the uteri began to increase in size.

In another stock, two animals with cystic ovaries refused to mate, four animals ovulated as the result of fights, the ovaries of two were inactive, while in the ovaries of four atresia was marked. In cases of atresia the number of large follicles was small. Differences in methods employed on

DIAGRAM OF REPRODUCTIVE CYCLE

(1) Multiple ovulations; (2) No ovulation; (3) Single ovulation



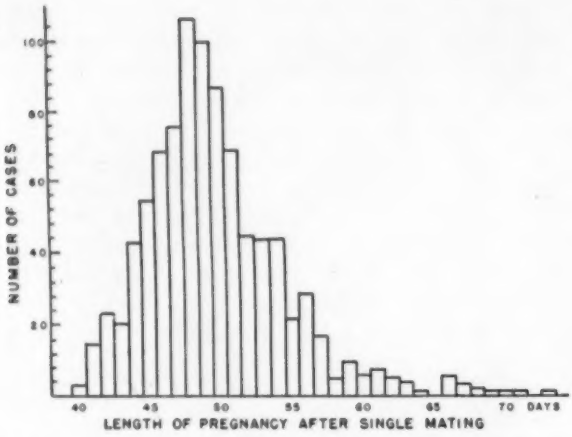


FIG. 3. Frequency distribution of length of pregnancy following a single copulation. Data from several herds.

the ranch and in the laboratory probably account for the difference in the number of animals that ovulated without copulating. No explanation can be advanced for the difference in the number of animals with inactive ovaries in the two groups unless the larger number found in the ranch herd is due to genetic factors following in-breeding or to some detail of housing or care.

If fighting without copulation induced ovulation, it is fair to assume that the females that behaved thus were ready to ovulate but for some reason not clear refused to copulate. The number of corpora present was normal. To this must be added cases in which follicles of full pre-inseminal growth were present but were not activated by fighting. In contrast to this behavior is that of one animal that copulated but whose ovaries were inactive. Ovarian cysts were present in 4 cases where animals refused to mate.

To summarize the ovarian conditions found in females that refused to breed and that were killed toward or at the end of the normal breeding, atretic follicles, with or without uterine activity, appeared in 9, 7 animals ovulated after fighting with males but without copulation, in 5 animals the ovaries were inactive, and in 4 cases ovarian cysts were present.

DURATION OF PREGNANCY

Variation in the duration of pregnancy in the mink is great (fig. 3), possibly greater than in any other mammal; it varies from 40 to 75 days (Coues, 1877; Seton, '29; Svihla, '31; Allen, '40; Apelgren, '41; Bowness, '42; Pearson and Enders, '44; Hansson, '47). One writer (Howard, '39) says ranchers have reported gestations as short as 37 and as long as 91 days. Kits born on the forty-first day following copulation appear to be slightly immature, and, in our limited experience, are not likely to survive. The length of pregnancy as given is from insemination to birth. Since ovulation normally follows insemination by approximately forty-eight hours, the period of pregnancy should be stated as being two days shorter than the figures given above. For practical reasons the beginning of pregnancy is, nevertheless, figured from copulation to parturition.

Most breeders of mink have tried to secure two or more copulations per female, since they feel that the size of the litter might be dependent upon the number of copulations (fig. 6). Owing to this practice the number of females used in figure 3 is rather small considering the large numbers of mink kept.

The mean length of gestation in the mink is approximately 51 days (Pearson and Enders, '44). Working in Sweden, Alm (Johansson, '40) found the mean gestation period of 264 mink to be 50.8 days, and Apelgren ('41) obtained a mean of 51.7 days for 459 pregnancies that were preceded by a single mating. We do not know whether or not the figures obtained by Alm were used in the work by Apelgren. Bowness ('42), working in eastern Canada, reported a mean length of 50.95 days for 747 pregnancies; his figures were taken from the records of ranchers sent in to him for study. Figure 4 shows the results of his study. Our figures, compiled from the records of many ranches, the U. S. Fur Animal Experiment Station, and from our own colony, show a mean of 49.66 days for 924 pregnancies which followed single matings, with a standard deviation of 4.89 days. More than 20 per cent of the pregnancies were longer than the 45–55-day period delimited by the standard deviation. In other words, the relation between mating and parturition in mink is rather tenuous.

Because ovulation follows insemination by about 2 days, variation of the duration of pregnancy is not affected by more than a few hours by variations in the relation of insemination to ovulation. Other factors to consider in explaining the differences shown in figures 4 and 5 may be (1) size of female, (2) size of litter, (3) remating, (4) age of female, (5) date of insemination, and (6) delayed implantation.

EFFECT OF SIZE OF FEMALE

If these is any relationship between the size of the female and the length of pregnancy this study

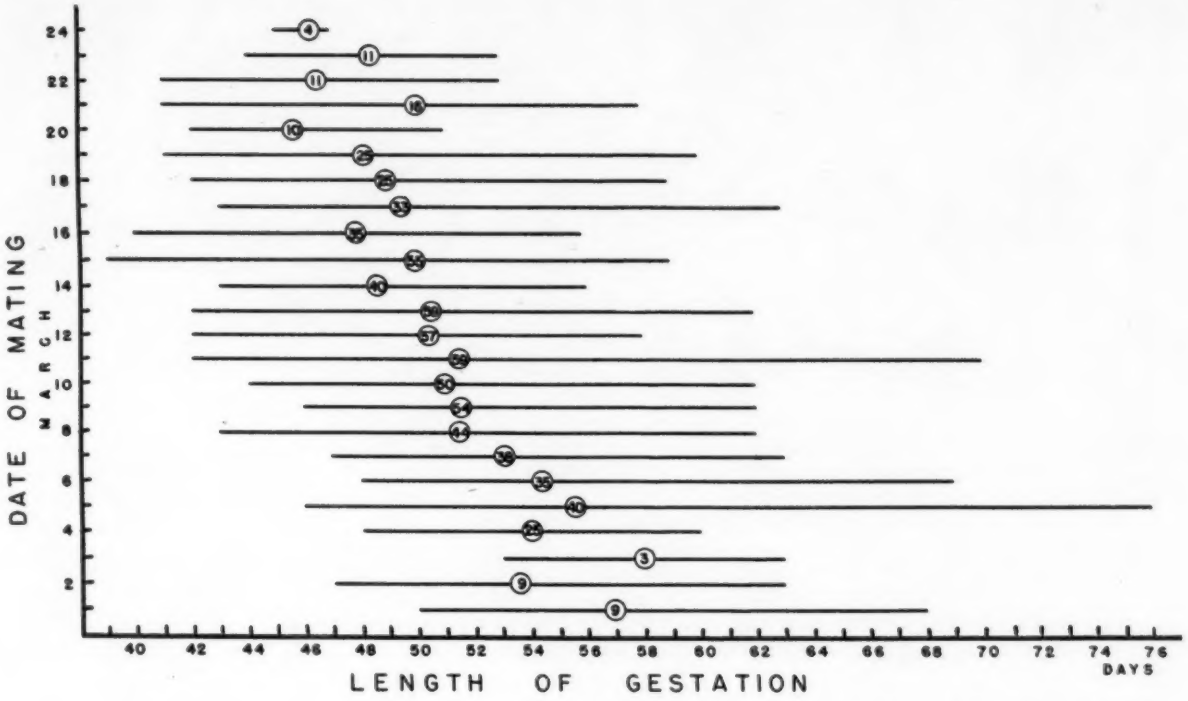


FIG. 4. Relationship between mating date and length of gestation in mink. Compiled records of 747 single matings published by Bowness ('42). The location of each large circle marks the mean gestation period of all the mink mated on that date. The number in each circle is the number of mink mated on that date, hence the number of cases used to obtain the average. The horizontal lines connect extremes of gestation for each date. The tendency for early-mated mink to have longer gestation periods than those mated later in the season is clearly shown, not only by the average gestation periods, but also by the extremes.

failed to demonstrate it. When more data are available they will be analyzed to supplement the scanty material thus far available.

EFFECT OF REMATING

Hansson ('47) shows that pregnancy in females remated after an interval of a week or more is shorter by 2.6 days than in animals that accepted only a single mating. His figure for single matings is 51.33 days and for double matings 45.6 days with standard deviation of 5.42 and 3.74 respectively. There was no relation between the length of pregnancy and the length of the interval between copulations. This may indicate, as Hansson points out, that females that remate differ in some way from females that mate but once. It occurs to us that the shortening may be due to the presence of 2 sets of corpora lutea and an earlier implanation date because of the increase in hormonal secretion. Larger litters from single matings are associated with shorter pregnancies which may be due to the larger number of corpora lutea as well as to other factors.

EFFECT OF SIZE OF LITTER

There is a slight but definite tendency for large litters to be associated with short pregnancies, and small litters to be associated with long pregnancies. Apelgren ('41) states that for each increase of one kit in the size of the litter, the length of pregnancy is decreased by 0.35 day. In two herds not under our control, the correlation between the length of gestation and the number of kits raised to the age when their sex was recorded was low but significant. In 128 litters resulting from single matings on one farm (L), the correlation was $-.20 \pm .08$ (S.E.), while in 215 litters on the other farm (T), the figures were $-.20 \pm .07$ (S.E.). The significance of our figures is even more striking because they are not corrected for the date of insemination.

EFFECT OF AGE OF FEMALE

In America the mean mating date of yearling females does not differ significantly from the mean mating dates of the same individuals in their adult years. Apelgren ('41) found that the mating date

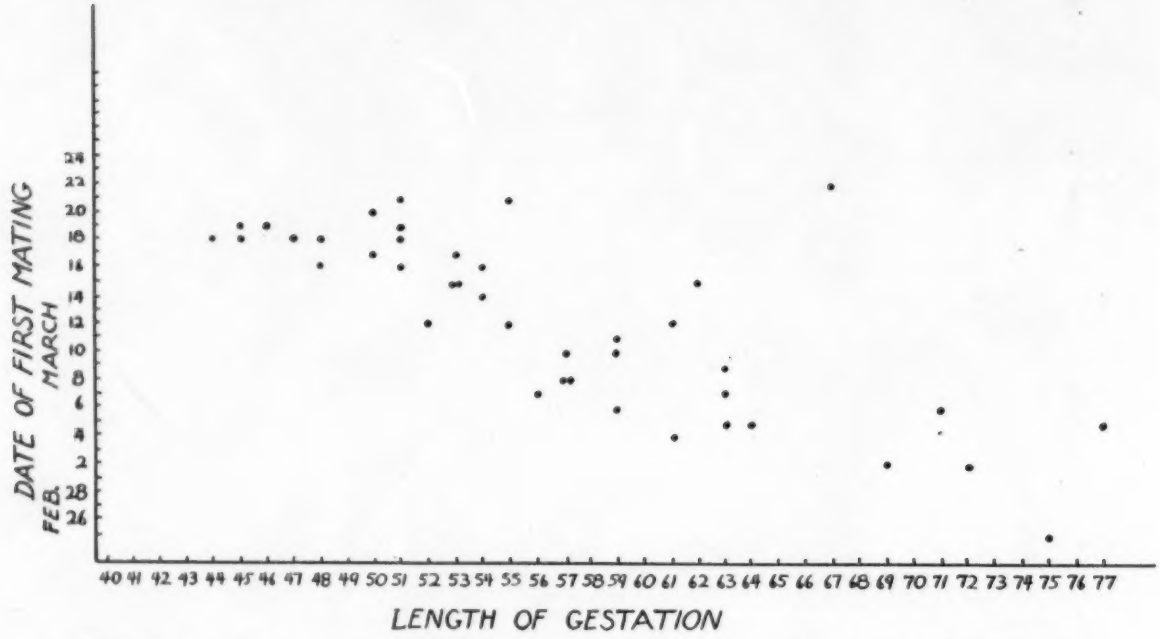


FIG. 5. Relationship between date of first mating and length of gestation in a single herd of inbred mink.

of yearling females was approximately 2 days later than that of the older females, but he does not say whether he compared the same individuals through several years. Nor did he find any difference in length of gestation between yearlings and older females. In one herd (L) the mean whelping date of yearlings was 1.9 days later than when they were adults, which is statistically significant, and in another herd (T) the adults whelped 2.2 days earlier than they did as yearlings. Size of litter did not affect the results in these herds for in one herd the yearlings had larger litters than the adults while in the other herd the reverse was true.

We cannot explain the difference between Apelgren's findings and ours. Nevertheless, we believe our figures show that gestation is longer in yearlings than in the same individuals when older.

EFFECT OF DATE OF INSEMINATION

Ever since large numbers of mink have been bred in captivity, ranchers have remarked that, while the period during which copulation took place was as long as 5 weeks, all the litters arrived within a shorter period, say 1 to 3 weeks. This was investigated by Apelgren ('41) and Bowness ('42), both of whom demonstrated that a correlation between the length of gestation and the date of mating was responsible and that early mated mink had long gestation periods, while pregnancy was brief in mink mated later in the season (figs. 4, 7).

On one ranch studied the mean length of gestation was 51.00 days, with a standard deviation of 5.3 days. In this herd the correlation coefficient between the date of copulation and length of pregnancy was $-.48 \pm .03$. This is significant and is in agreement with the figure given by Apelgren ('41), which was $-.506 \pm .035$. The regression equation for the herd studied by Pearson and Enders ('44) was: Length of gestation = 59.31 days minus .44 × mating date. With the use of this equation the average gestation period resulting from copulation in March can be calculated. Dates in February can be used by substituting 0, -1, -2, etc., for February 28, 27, etc., and dates in April can be used by adding the date to 31.

Delayed Implantation

In the writings in the trade journals and in books on mink breeding, the assumption is made that the length of gestation is always constant but that the differences encountered in the time that elapses beween insemination and birth are due solely to delayed fertilization (Laberee, '38). The usual figure given for the time between ovulation and parturition is 42 days. If this is the case sperm must survive in the female as long as 33 days when copulation and parturition are 75 days apart. This is difficult to accept in view of the

fact that the same argument has been advanced for the marten, in which the copulation-parturition period is more than 240 days. Recent work (Wright '42*a*; Marshall and Enders, '42; Enders and Pearson, '43*a*; Pearson and Enders, '44) has proved that the long gestation period of the marten is not due to delayed ovulation, but to delayed implantation. The same is true of the European badger (*Meles taxus*) (Fischer, '31), the American badger (*Taxidea taxus*) (Hamlett, '32), the long-tailed weasel (*Mustela frenata*), and the short-tailed weasel (*Mustela cicognani*) (Wright, '42*a*), and the fisher (*Martes pennanti*) (Enders and Pearson, '43).

Both Enders ('39) and Johansson ('40) advanced the idea in the mink that delayed implantation might be the cause of the differences in length of gestation. Neither Enders nor Johansson offered any proof. Hansson ('40), a student of Johansson, undertook to demonstrate that such a delay occurs in mink. He killed 6 females 10 days after copulation, sectioned the uterine horns, and found embryos in 5 of the animals. The number of embryos agreed, on the whole, with the number of corpora lutea in the ovaries. Hansson found that the stages of development were not the same in the different females. The most advanced embryos corresponded in development to 6- or 7-day-old pig embryos. Hansson argued that since gestation in the pig is 114 days and in the mink 40 to 47 days, and that a 6- or 7-day-old pig embryo is as far advanced as a mink embryo 10 days post-coitum, this suggests a period of delay, that the length of this delay varies in the mink, and hence the duration of pregnancy varies. He cites the fact that a 33-day-old-mink embryo corresponds in development to a 22-day-old pig. Hansson ('47) carried this work further. He found unimplanted blastocysts 16 days after breeding. On the twentieth day 2 females contained unimplanted blastocysts while one contained ". . . blastulae with some tendency to adhere to the uterine mucosa. . . ." Thus in this female implantation had begun (p. 61). These animals were killed on the fourth, fifth, seventh and ninth of April. In a fourth female Hansson reports implantation and development to such a stage that he says implantation took place immediately after the blastocysts reached the uterus which, according to his calculation, is 8 to 10 days after mating. Since this female re-bred 12 days after the first mating, this is a surprising finding, for she re-bred after implantation had taken place. Animals killed 22 days after mating showed implantation but in one case unimplanted blastocysts were found 25 days after mating. The female was mated on the ninth of March and autopsied on the third of April (Hansson, '47: table 18).

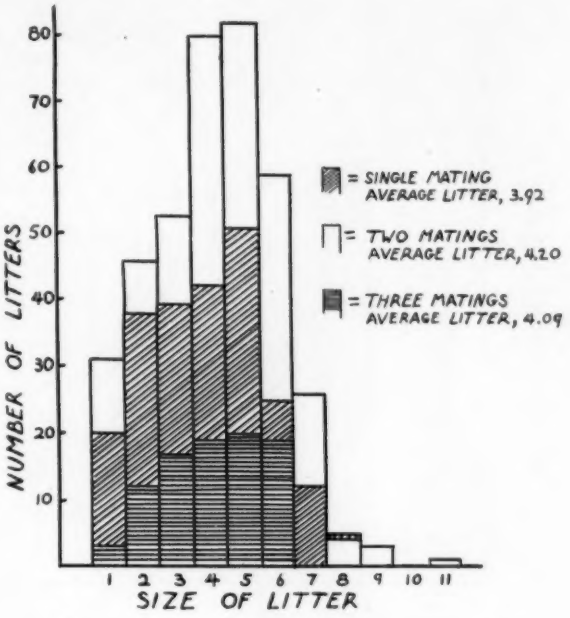


FIG. 6. Relationship of size of litter to number of copulations.

If instead of length of delay in days the date of implantation is sought, Hansson's table shows the earliest implantation found was on April 2. No unimplanted embryos were found after April 9.

In the meantime a study of implantation in the marten led to the belief that a longer or shorter delay in implantation might be responsible for the great variation in the length of gestation in the mink. Increased length of day caused blastocysts to implant in the marten (Enders and Pearson, '43*a*); the date of insemination in mink influenced the length of gestation; implantation in the mink took place when the length of day was increasing; and Hansson's work showed that blastocysts were free in the uterus 10 days after mating. To find out what, if any, connection there was between these observations, mink were mated once, and at intervals their uteri were removed, sectioned, and examined microscopically. Forty-seven blastocysts were found in 15 uterine horns that had been removed 11 to 20 days after copulation. The zona pellucida was still intact in all these blastocysts, they were free in the uterine cavity, and not one showed any sign of implantation. Some of these mink had been mated early in the season and others were mated late, yet implantation had not

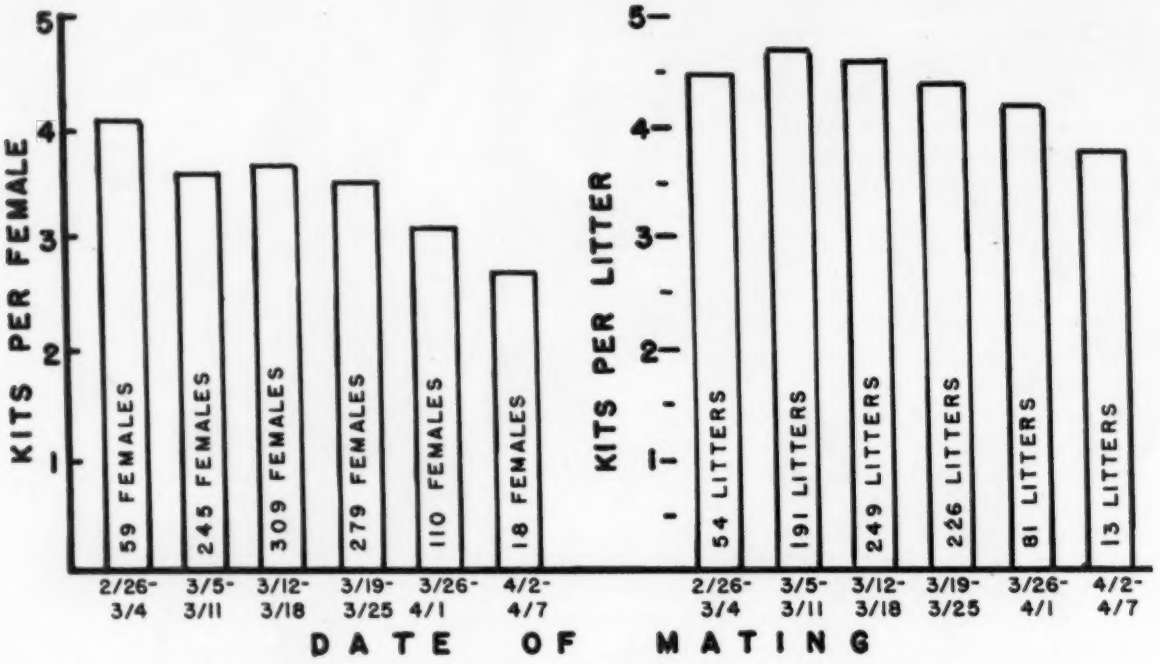


FIG. 7. Relationship between date of mating and fecundity, using data from single mated females. Data from many sources.

occurred in any of them, apparently proving that a considerable delay in implantation is of normal occurrence regardless of the date of mating.

By removing one ovary, together with the oviduct and horn, from each of 27 mink 2 or 3 weeks after copulation it was possible to obtain an estimate of the proportion of the gestation period spent in the implanted state. The longest pregnancy lasted 52 days, yet the blastocysts were unimplanted on the twentieth day when one horn was removed. The maximum duration of embryonic attachment was, therefore, about 31 days, granting that implantation occurred in the intact horn the day following the operation. In another case the duration of attachment could not have exceeded 32 days and in another 30 days.

In a series of animals bred between March 20 and 22 implantation had taken place on April 11, 13, 13, 14, 14. Copulation ages were 20, 24, 24, 23, and 23 days. One animal killed on April 11, 20 days post-coitum, contained unimplanted blastocysts. Apparently, in animals bred at or near the middle of the breeding season, implantation occurs on or about April 11 and 20 days after copulation or 18 days after ovulation. All animals of this series examined after April 11 had implanted embryos. In another experiment one animal ovulated on February 28 and the eggs did not implant until after April 10 so the blastocyst remained free in the uterus for at least 30 days and probably longer.

Animals in this series bred March 20–22 which had one horn of the uterus removed and the intact horn left *in situ* to go to term, averaged 47–49 days of gestation. If implantation took place on or about April 10–12 as it did in 4 cases 20 days post-coitum, implantation lasted 27 to 29 days. No matter what the date of copulation, in no case did gestation after implantation last more than 33 days nor less than 27. Because of the difficulty of determining the exact moment of implantation it is probable that 28 days is the minimum figure. The length of pregnancy after implantation is, therefore, about the same in the mink and ferret (Hamilton, '34). Young weasels are born 21 to 28 days after microscopic swellings become visible in the uterus (Wright, '42*b*). In connection with the work outlined above, Pearson and Enders ('44) demonstrated that the great variability in the length of gestation was caused by variation in the duration of the pre-implantation period; after the blastocysts become implanted growth is probably at the same rate in all individuals. The young are probably born 28–30 days after implantation. Two of their groups of mink were subjected to experimental illumination:

. . . They were bred early in the season because it was felt that the long gestation periods of early-mated individuals would respond more readily to increased illumination. The average gestation periods of these two groups were compared with the average gestation of mink that had mated early in the season also but had not been illuminated.

The first group, composed of twenty-five females, was subjected to artificial illumination beginning February 2nd. The lights were adjusted to increase the length of day about 1½ hours. Eleven of these illuminated females mated either once, or on 2 consecutive days, between February 25th and March 5th. The others either refused to mate or failed to mate within the specified period. Two copulations on consecutive days were obtained whenever possible because this breeding practice reduces the percent of females that fail to become pregnant. The gestation periods have been calculated from the first mating, since it is the one that causes ovulation in the majority of cases. Ten litters were obtained from this group of eleven females; the mean gestation period was 49.4 days.

Another group of twenty-one females was bred during the same period, February 25th to March 5th, but was not illuminated until the evening after mating. It was then subjected to the same artificially-lengthened day as the first group. Nineteen litters were born; the mean length of gestation was 50.5 days.

These two averages should be compared with the average duration of pregnancy in mink mated between the same dates but not subjected to lengthened days. Two such control averages are given in table 2. One of these was derived from the gestation periods, in former years, of mink that belonged to the same colony as the illuminated animals. Unfortunately there were only four eligible animals mated earlier than March 5th, so it was necessary to include in this average animals mated March 9th or earlier. In this way enough cases became available so that a significant average could be obtained. The slightly later mating dates would tend to shorten the average gestation period of this group. This would decrease any difference between the experimental and control groups, and thus would tend to conceal any effect that illumination might have had. The other control average was derived from the gestation periods of mink mated between February 25th and March 5th on a number of other ranches.

An examination of the average gestation periods presented in table 2 discloses that pregnancy was shorter in both illuminated groups than in the control groups. Statistically the difference between the illuminated and control groups is probably significant, although it must be kept in mind that the number of cases averaged is uncomfortably small. As might be expected, pregnancy was shorter in the animals illuminated before and after mating than in those illuminated only after mating. The difference between these two groups is not statistically significant, and therefore it might not be confirmed if the experiments were repeated using a very large number of animals. The fact remains that, even when illumination is not begun until after copulation, the stumulus provided by lengthened day has time to take effect several days before implantation would have occurred normally, thus shortening the gestation period by a significant amount.

The spread of gestation periods from 47 to 52 days in the first illuminated group appears to be unusually small, and the fact that not a single long gestation period occurred in this group seems worth noting.

In an earlier experiment an attempt was made to lengthen pregnancy by shortening the day. Seven bred females were placed in an enclosure in which the length of daylight could be shortened by 1½ hours. The resulting pregnancies, recorded in table 3, do not appear to have been lengthened appreciably by this procedure.

TABLE 2[1]

LENGTH OF GESTATION OF TWO EXPERIMENTAL AND TWO CONTROL GROUPS OF MINK

All were mated between February 25 and March 5 except the group marked,* which includes mink mated between Februaty 25 and March 9.

	Number of cases	Length of gestation in days		
		Longest	Shortest	Mean
Illuminated before and after mating	10	52	47	49.4±.29
Illuminated only after mating	19	57	46	50.5±.49
Not illuminated. Same herd in former years*	20	66	46	54.7±.80
Not illuminated. Other herds	91	70	43	53.1±.37

[1] Tables 2 and 3 are tables 3 and 4 of quoted material.

TABLE 3[1]

LENGTH OF GESTATION OF MINK SUBJECTED TO A DECREASED LENGTH OF DAY AFTER MATING

Gestation does not appear to be any longer than normal

Date bred	3/13	3/15	3/22	2/29	3/29	3/31	4/1
Length of gestation	51	48	47	48	46	46	45

The length of gestation is influenced possibly by the age of the female, slightly by the size of litter and greatly by the date of insemination (fig. 4).

The duration of pregnancy is determined or limited by two sets of events: mating-ovulation

and implantation-parturition. The extent to which these two complexes are unconnected is indicated by the great variation in gestation, for there is very little variation in the time between mating and ovulation, and between implantation and parturition. The unconnected nature of these two sets of events is also shown by the fact that among single-mated females, the standard deviation of the mating dates is considerably greater than the standard deviation of the birth dates. In other words, although the matings are spread over a considerable period, the birth dates of the young are less scattered.

The loose relationship between mating-ovulation and implantation-parturition and the fundamental difference in the nature of these two processes are underscored by the fact that the tendency of individuals to mate on the same day in successive years is not so great as the tendency to whelp on the same date. Thus among the 84 females in a herd (L) that had kits in their yearling year and in one or more later years there was no correlation between the first mating date in the yearling year and the mean mating date in subsequent years ($+ .09 \pm .11$ S.E.), but among these same females there was a significant correlation between the date of whelping in the yearling year and the mean whelping date in subsequent years ($+ .29 \pm .10$ S.E.). In other words, there was a tendency for the females of this group to whelp on the same date each season in spite of the fact that there was no tendency to mate at the same time each year.

A similar phenomenon was shown by another herd (T), although this herd differed because individual females showed some tendency to mate at the same time each season, which was probably planned that way by the manager, rather than being a natural expression of preference by the mink. The tendency for an individual to mate at the same time in several seasons was indicated by a correlation of $+ .27 \pm .05$ (S.E.), but the correlation of whelping dates in several seasons was considerably higher, $+ .45 \pm .04$ (S.E.).

Mating and its consequence, ovulation, may take place almost anytime within a period as long as five weeks, the time of mating or matings being dependent upon the male and female meeting under favorable circumstances. In the wild, matings are the result of travel by the male bringing him within the territory of the female at a time when she is receptive. On the ranch, matings are the result of a whim or a plan executed by the rancher.

Mink are peculiar in that they may mate for many days after ovulation, probably more than 28, so throughout the discussion of the duration of pregnancy single matings have been used. There is some evidence that the date of the last mating is limited by the events that initiate the implantation-parturition sequence rather than with the first mating-ovulation sequence. There is, for example, a higher correlation between the last mating date and whelping date ($+ .55 \pm .03$ S.E.) than between the first mating date and parturition ($+ .46 \pm .03$ S.E.). Gestation always lasts more than 35 days after the last mating and in all except 3 per cent of the pregnancies it lasts more than 41 days after, so mink probably go out of heat at least 5 days before implantation. Possibly the same hormonal changes bring an end to breeding and initiate the changes that allow implantation of the resting blastocysts.

Apparently Hammond ('51*b*) believes that the time of implantation is controlled to some extent by estrogen. He bases part of his argument on Hansson's ('47) statement that progesterone does not prevent the vaginal smear from reverting to the post-estrous condition when injected during the breeding season. Furthermore, in reporting the failure of progesterone treatment to affect delayed implantation one of the conclusions Hammond reaches is "besides the presumed increase of the luteal secretion, implantation requires the presence of an extra-ovarian factor acting upon the uterus, or passing . . ." some secretion to the blastocysts. Migration of the blastocysts and implantation in the marten takes place, as it does in the mink, under the stimulus of increasing length of day so it was suggested under the discussion of uterine migration that the pituitary was involved in stimulating the corpora lutea and that the pituitary might be involved directly.

Superfetation and Superfecundation

The earliest suggestion that superfetation is found in the mink was made by Cavan ('44). Three cases suggesting superfetation have been reported personally by able and experienced mink breeders. Kits had been born to the females, but in each case the mother lost them, apparently through neglect. Following the death of the kits the females were moved to new nests where, some time later, kits were found. These females had bred twice and the breeders felt sure that the second litter was the result of the second mating. Many breeders are positive that this occurs frequently but is not detected because the litters are

born only a few days apart and the "first" litters do not die. In a fourth case (Anon. '45*b*) one litter was reported to have been born April 26 and another May 14. Reports of "split litters" continue to appear in trade journals (Rick, '46; Anon. '50).

At birth the mink kit is flesh colored for no hair or pigmentation is present. Kits born to a small strain averaged 8.3 cm. in length for females and 9.1 for males. Throughout the growth period males and females can be separated at a glance because of the differences in size. Growth is very rapid and four days after birth females are 9.2 cm. long and males 10.1 cm. Hair is visible and pigmentation is noticeable. The males continue to grow at a more rapid rate than females. Although there are a few "runts" most litters are remarkably uniform in size and development. It is impossible to tell whether the litter came from an early or late mating or whether it came from two or more matings unless the kits show some genetic factor that indicates the sire. This uniformity in size and development is an indication that all of the kits were implanted and began development at approximately the same time.

The first scientific basis as to how superfetation could come about was Hansson's ('44) finding that ovulation always took place following a second mating provided the interval between the first and second matings was six days or longer. A few of the females he studied ovulated anew if remated less than six days after their first copulation but none ovulated a second time when the interval was four days or less. Shackelford showed the writer a beautiful experiment supporting this. Shackelford injected india ink into the ruptured follicles of a recently bred mink, kept her for a period longer than 6 days and had her bred again. When she was killed for examination the india ink marked the corpora lutea of the first ovulation and there were freshly ovulated follicles in addition to the ink-laden corpora. We repeated Hansson's experiments and verified his results.

With this knowledge and the development of mutations it became possible to determine whether superfetation or superfecundation was responsible for litters that appeared to be from different ovulations. Among the first cases reported was one in 194 (Anon., 34). A litter containing a "Black Cross," three "Silver Sables," and two dark kits was born to a natural dark female. The female had been mated to a "Black Cross" male on March 12 and to a "Silver Sable" male on March 23 and the litter was whelped on May 8. Because the matings were 11 days apart it is unlikely that superfecundation is involved, because under these conditions the female probably ovulated twice and because there is no proof that sperm could survive for the 13 days that elapsed between first insemination and the second ovulation.

Shackelford ('48: 164) reported that 27 litters were born to dark females that had been bred once to a dark male, then to a homozygous "Royal Silver" male. By using two types of males he was able to determine which of the two males sired the kits. Of these litters 21 contained all "Royal Silver" kits and were, therefore, from the second mating, 2 contained only dark kits from the first mating, and 4 litters were composed of kits sired by both males.

Johansson ('50: 290) summarizes some of his experiments indicating superfetation and superfecundation. He, too, used mutation males and natural dark females so each kit carried the color of the male parent. In the first series a female was bred to a dominant mutation male and on the following day the female was bred to a natural dark male. In 3 litters there were 6 live kits: 4 were from the first mating and 2 from the second. This is superfecundation for under these conditions the female ovulated but once. In passing it should be pointed out that the older sperm fertilized 4 of the eggs. While the numbers are small this proves that superfecundation takes place in the mink. In a second group of 13 females two matings were permitted with an interval between matings of 7–12 days. Of 62 kits produced 5 were from the first mating and 54 from the second, three unknown. In the third group females were mated with a silver blue male, the second mating a day later was with a standard dark male and after an interval of 7–12 days the mink were mated to black cross males. Of the 51 kits born 10 were from the first mating, one from the second, 23 from the third, 17 unknown. While the results are not broken down so that one is sure of it there may be an indication here that both superfecundation and superfetation have occurred.

In Shackelford's ('48: 164) series approximately 3 per cent of the kits were from the first mating when 6 days elapsed between matings. Most commercial mink breeders are sure that it is the last mating that produces the kits. However, the results of Johansson's work quoted above and of another set of his experiments indicate that this is by no means true. In two experiments he showed that where the interval between matings was one day 14 kits were from the first

mating and 29 from the second, but when the interval between matings was lengthened to 8–11 days 7 kits were from the first mating and 43 from the second. This last indicates 14 per cent of the kits were from the first mating. These figures indicate that in superfetation a smaller percentage of the kits are from the first breeding than when there is superfecundation.

How can this be explained? In the case of superfecundation it may be that the sperm from the second insemination are in better condition when ovulation occurs than those 24 hours older. In superfetation this could not be the case for although there are no direct experimental data to prove it the survival of sperm in the female reproductive tract for a week or more is unlikely. Since ovulation follows insemination by approximately 48 hours and fertilization appears to take place almost at once it is probable that the eggs are fertilized and have reached the uterus 6–8 days after insemination. In two cases Hannson ('47: 60) found blastocysts in the tube 8 days after mating and in one case the blastocysts had reached the uterus in 8 days. In any mating more than 2 days after and up to 8 days after the first insemination sperm from the later insemination would be likely to encounter developing blastocysts in the tubes. After this time the blastocysts would be at rest in the uterus and sperm from subsequent insemination would pass then on their passage to the tube.

Recently Johansson and Venge ('51) working in Sweden and Shackelford (MS) have written superfetation in the mink. Both researches indicate that, as the interval between two ovulations lengthens, there is a rise in the proportion of kits born from the eggs released at the first ovulation. There is no explanation as to why the longer the interval between two fruitful matings the higher the rate of survival of the embryos from the first mating.

Three explanations of the predominance of offspring of the second ovulation occur to the writer. First there may be something in the semen that acts on the blastocyst or there may be competition for implantation sites between the two sets of blastocysts and the younger blastocysts are the victors. This can be proved experimentally but so far as we know it has not been done. A third explanation is possible: the rise in FSH, estrogen, LH, or some other hormone connected with the second ovulation may have a harmful effect on the blastocysts. It should be pointed out that there is no generalized reaction of the endometrium until the end of the breeding season, so pregesterone is not involved. Bayorsky, Bayles, Casida, and Meyer ('47), using rats, found that ova produced in the luteal phase show a low incidence of fertilization. If the luteal phase were involved here, it is unlikely that the ova from the second insemination would be represented in such a high proportion in litters born from two breedings 8 or more days apart.

Hansson ('47: 48) offers still another explanation. He found fertilized eggs from the first ovulation in only 2 of 27 cases where a second mating had produced another group of fertilized ova. So the ova from the first ovulation tend to disappear following a second mating and ovulation. But in females that did not ovulate a second time fertilized eggs from the first mating were found, a fact in keeping with the observation that in some females that have been mated twice the entire litter is from the first mating. Hansson argues that it is therefore not the act of mating that leads to the destruction or elimination of the fertilized eggs of the first ovulation. He says that these "eggs must be ejected through the cervix in connection with the second ovulation" (*loc. cit.*). The great increase in motility of the uterus may be responsible. If this is the explanation, it must mean that the motility of the uterine tract that is so pronounced at about the time of ovulation occurs only if ovulation takes place but not if ovulation does not follow copulation.

Shackelford ('48: 164) states "something connected with the second ovulation usually prevents the implantation and development of the blastocysts from the first mating." In one of our cases in which the female had ovulated twice with 8 days between ovulations, several degenerating blastocysts were found in the proximal end of the uterus. Degeneration had progressed so far that only inner cell masses and scattered trophoblastic cells could be found imbedded in a reticulum of coagulated secretion of unknown origin. The uterus had been removed 5 days after insemination, so it is possible that the coagulum was semen. That semen is not responsible for the destruction of the blastocysts from previous ovulations is indicated since a second insemination without producing ovulation does not destroy them. The lining of the uterus appeared to be unusually active in this region which extended for about 1.5 mm. However, that all blastocysts are not destroyed by subsequent ovulations is clear for in cases

where the kits are from 3 ovulations one set of blastocysts must have survived 2 later ovulations.

One is forced to conclude from this evidence that both superfecundation and superfetation occur under natural conditions in the mink.

Prenatal Death

If each ovary sheds an average of 4.9 ova, and litter size averages 4.4, more than half of the eggs fail to be fertilized, fail to implant, or the embryo fails to reach full development.

In a wild rodent, *Microtus*, Hamilton ('41) found that the percentage of ova fertilized and implanted under natural conditions varied from 89.68 in January–March to 83.15 in July–October. "Resorption" was recognized to the extent of 3.58 per cent during January–June 1936 when embryo counts average 5.4 per mouse, and 1.8 per cent during July–December of the same year when embryo counts average 4.9 per mouse. No such figures are available for the wild mink, but our figures indicate that in ranch mink the percentage of ova lost between ovulation and birth is nearer to 50 per cent than to Hamilton's figure for the field mouse. Brambell's ('42) findings in the wild rabbit, *Oryctolagus cuniculus*, that "between 45 and 58 per cent of al ova ovulated must have been lost" (p. 476) indicate that losses as high as those reported in the mink are normal for some mammals. Losses in the rabbit are not through failure of fertilization or of implantation but through losses occurring chiefly from the eleventh to the fifteenth day of gestation.

In swine a loss of 31.3 per cent from ovulation to parturition has been reported (Phillips and Zeller, '41: 440).

Robinson ('21) studied prenatal death in the ferret, which differs from the mink in so far as there is no delayed implantation of variable length. Microscopic examination of the ovaries of 165 ferrets showed an average of 9.95 ova produced per pair at each ovulation. But ferrets average only 6 per litter, hence suffer a prenatal death rate of 39.23 per cent.

In the mink Hansson ('44: 407) found that in 120 females the average number of eggs released at ovulation was 8.71 ± 0.30. In our series the average was 9.8. In Sweden he reports 4.37 kits per litter. The loss between ovulation and parturition is, therefore, about 50 per cent.

Possible Causes of Prenatal Losses

The long period that elapses between insemination and fertilization in mink may account for such large losses because the sperm lose viability before the ova are released. Because of the difficulty in carrying on artificial insemination in mink, this point was not tested as it has been in the guinea pig (Blandau and Young, '39) and in the rat (Blandau and Jordan, '41). That no great portion of the loss occurs through failure of fertilization is indicated by the figures quoted from Hansson ('40) as well as by data obtained in this study. Few unfertilized eggs were recovered. It, therefore, appears doubtful that the failure of fertilization is responsible for the losses occurring between ovulation and birth in the mink.

Elsewhere it is pointed out that the presence of corpora lutea does not entirely suppress the growth of ovarian follicles. Follicles keep the estrogen level of the blood high enough to bring about mating in some females. It is possible that this high level of estrogen may be responsible for some of the losses, since Courrier and Gros (quoted by Allen *et al.*, '39: 506) found that "nidation of fertilized ova could be easily prevented in the pregnant cat by the injection of estrogen." The relation of this observation to length of gestation has been discussed.

The unequal development rate of the blastocysts (p. 57) may indicate that the smaller blastocysts were doomed to early failure, but the total number of blastocysts recovered agreed closely with the number of ova shed. The great loss, therefore, takes place after fertilization and after the blastocysts have reached the uterus. Since matings during the height of the season produce larger litters than early matings, there is some indication that delayed implantation leads to prenatal losses. But matings late in the season are also less productive. Embryo counts in the mink indicate a greater difference between number of ova shed and number of blastocysts implanted than between number of blastocysts implanted and the number of kits produced. Hansson ('47: 114) states that "of 100 eggs an average of 83.7 are implanted, and 50.2 result in kits." Probably, as in the ferret, the losses occur throughout the period of gestation.

What determines how many blastocysts will implant and how many implanted blastocysts will develop into viable kits? Runner ('51: 19), studying the survival of mouse eggs, concludes that "certain types of mothers" are "more reproductively efficient than others," and that "maternal factors effectively restricted the numbers of young in certain females." In the sheep (Robin-

son, '51 : 150) the number of ova shed is "the main factor controlling the number of lambs born" but this is not true of the mink even when but one ovulation takes place. Certainly when two or several ovulations occur, the death of blastocysts or failure of more than a fraction of the blastocysts produced by multiple ovulations to implant, is limiting factors in the size of the litter. It appears, therefore, than in the mink the number of kits produced depends in a few cases upon the number of eggs ovulated, in some cases on the number of blastocysts that implant and, where there is implantation of a considerable number of blastocysts, upon the ability of the uterus to support them.

SIZE OF LITTER

Practice in counting kits varies. Few breeders count litters at or shortly after parturition because of the nervousness of the female. Some caretakers count the kits 2 or 3 weeks after they have been heard but others do not count the young until they are weaned. For this reason the counts are not strictly comparable. This must be kept in mind during the discussion of the size of litters. Another factor that may be responsible for some variation is that large litters tend to decrease more than small litters as time passes (Johansson, '40).

Litters as large as 17 have been reported for mink but litters of 10 or more are infrequent. Individual production records of 32 kits in 3 years (Manring, '44 : 10), of 15 kits in one year and of 9 the next (Anon. '46 : 240), and 2 females each bearing 17 kits of which 15 survived (Penniman, '50 : 8) appear to represent maximum breeding performance. At Lido, Sweden, Johansson ('40) reports on 740 litters of "Quebec mink" which average 4.67 kits and 130 litters of "Alaska mink" which average 4.74 per litter. These averages are from an experiment station and are higher than those achieved by most breeders in this country. Large scale production may average 3.5 kits per litter but many breeders never achieve this figure. A rancher with 25 years experience insists (McClintock, '48) that over the years a ranch average of 3 kits per female is usual. He questions the reports of higher averages. Gunn ('49 : 26) gives 2 to 2.5 as ". . . general average production for females kept. . . ." Bowness ('42) reports an average of 3.44 kits per female kept for breeding and 4.25 kits per animal bearing a litter. His figures were collected in such a manner that the more interested breeders, i.e., the more enlightened breeders, are represented, which explains the high average production. Skilled husbandmen equal and sometimes surpass an average of 5.0 but may not be able to reach this high figure year after year. Figures from several successful ranches are combined in figure 6. This shows a litter average of 4.48 kits per litter. The national average as reported by Francis was 3.2 in 1949 and 2.8 in 1950 (personal communication).

EFFECT OF SIZE OF FEMALE

Large strains of rabbits shed more ova than small strains, the difference being as great as 10 to 5 (Hammond, '41) and large breeds tend to produce a larger number of young per litter than smaller breeds (Pickard, '30; Gregory, '32). While the well established breeds of rabbits and the poorly defined "types" of mink are not comparable, it is interesting to recall that Johansson ('40) found no such differences in size of litter between the large "Alaska," which averaged 4.74 kits per litter, and the smaller "Quebec," which averaged 4.68. It is assumed, therefore, that size in mink has little or no effect on the number of kits per litter.

EFFECT OF LENGTH OF PREGNANCY ON SIZE OF LITTER

Working on his data from the point of view of effect of length of pregnancy on size of litter, Hansson ('44) states that in 51 cases in which pregnancy lasted 41–44 days litters averaged 4.67 whereas in 32 cases in which pregnancy lasted 61–64 days litters averaged 3.84. Table 39 (Hansson, '47) extends these observations. All our data indicate that breeding early in the season is not so productive as later breeding and that there are indications that not as many eggs reach the ovulatory stage early in the breeding cycle as later. Hansson believes ('44 : 408) that table 3 of his paper supports his statement that, in mink copulating only once, the number of kits per female decreases with the length of pregnancy. Our experience indicates that date of insemination and other factors must be considered. Hansson has considered these factors in another part of this important contribution. We believe that the relationship of fertility, i.e., kits per litter, to the length of gestation is not a simple relationship, and is, therefore, difficult to evaluate because other factors such as date of insemination play a more important role.

EFFECT OF MANAGEMENT

What influences the size of the litter in mink? The general assumption is that the tendency to have large litters is inherited in mink much as high milk production is in cattle or high egg production in chickens. There is some doubt that heredity plays much of a role in fecundity in mink. Apelgren ('41) states that the size of the litter is influenced by surroundings, basing his conclusions upon the analysis of records of females that have whelped in at least three successive years. The correlation between litter size in different years within these females was + 0.093 from which Apelgren concludes that approximately 10 per cent of the variation in size of litter depends on the female's individual qualities, and that about 90 per cent of the variation is dependent on accidental outside influences. While it is unusual to interpret a correlation of + 0.093 in this way there is no doubt that "outside influences" control to a remarkable extent the size of litters. High productivity, i.e., high percentage of pregnancies and large litter size, is correlated with skillful management and good breeding practice. Differences in results obtained from the same herd of mink kept under identical conditions as to all other factors but handled by different men in successive years demonstrate this beyond doubt. This ability to handle animals is intangible, but the results are strikingly apparent in the figures of production.

EFFECT OF BREEDING PRACTICE

Standard practice on many mink farms has been to mate females at intervals during the breeding season but some ranchers, either because the female refused to breed more than once or because of shortage of males or of labor, bred their animals only once. On three large commercial farms the records indicate that larger litters are obtained from single matings than from multiple matings. Many experienced mink ranchers have observed this (Moyle, '50: 23). However, fewer kits are produced from the herd for the number of non-pregnant females is high. When breeding data from the U. S. Fur Farm station were analyzed (Bassett, Wilke and Pearson, '44) "single matings resulted in a high proportion of non-pregnancies, the smallest average litter size, and the highest percentage of small litters" (p. 10). As they point out, frequent attempts were made to secure more than one copulation so they may have had a selected group of low sexual activity. Hansson ('47: table 41) too indicates that the percentage of non-pregnant females is high, but that the mean litter size does not differ greatly, being greater than when females were mated twice with an interval of 3–4 and 5–6 days between matings. There is agreement, therefore, that there are more non-pregnant females when but a single mating is used but it is impossible to reconcile the results as to the size of litter.

To test the effect of breeding practice Bassett, Wilke, and Pearson ('44) conducted an experiment based upon recommendations that were the outgrowth of a previous study (Enders, '40). They divided a herd into four groups: (1) females that mated but once, (2) females mated 2 days consecutively, (3) females mated 2 days consecutively and remated later, and (4) females mated two or more times, not on consecutive days. Table 4 gives their results.

There is no statistically significant difference between Group 2 composed of females that mated on 2 consecutive days, and Group 3 composed of females that mated on 2 consecutive days and remated later. Both of these groups were more fecund than Groups 1 and 4. Surprisingly, Group 4, mated two or more times not on consecutive days, produced larger litters than Group 1. When composite figures derived from several ranches over several years were used, little difference was found between groups comparable as were Groups 1 and 4. Is it possible that some phase of management was responsible for this difference and this is lost when several ranches are compared?

Hansson ('47: table 41) found improvement in reproductive performances of animals bred on two consecutive days with fewer "misses" than under any other system, while Bassett *et al.* reported lower production from two or more matings not on consecutive days. Hansson found improved reproductive performance when two or three matings were 6 or more days apart but when they were 3–4 days apart production was considerably lower. Animals mated 4–6 days apart showed the highest percentage of non-pregnant females and the lowest number of kits per female as well as the lowest mean litter size of any group. In the earlier paper of Bassett *et al.* there was no breakdown so results cannot be compared.

Moyle ('50) mated females once, and after an interval of at least six days bred on two consecutive days. Also he mated some females on consecutive days and a third time after an interval of 7 days. Under the first system the litter aver-

TABLE 4

PRODUCTIVITY DATA ON MINK FEMALES MATED BY DIFFERENT SYSTEMS

Methods of mating	Age	Females	Litters raised to weaning	Females not pregnant	Average per female	No. of kits per litter
		No.	No.	%	No.	No.
(a) Segregated by age (adults and yearlings)						
Mated once	Adults	92	74	20	2.88	3.58
	Yearlings	95	61	36	2.24	3.49
Mated 2 days consecutively	Adults	47	42	11	3.72	4.17
	Yearlings	59	51	14	3.46	4.00
Mated 2 days consecutively and remated later	Adults	9	8	11	3.78	4.25
	Yearlings	12	11	8	3.67	4.00
Mated 2 or more times, not on consecutive days	Adults	64	44	31	2.84	4.14
	Yearlings	72	48	33	2.64	3.96
(b) Segregated as to date of starting matings						
Date breeding season started						
Mated once:						
Before March 10		30	19	37	2.37	3.74
After March 10		157	116	26	2.59	3.51
Mated 2 days consecutively:						
Before March 10		0	0	—	—	—
After March 10		106	93	12	3.58	4.08
Mated 2 days consecutively and remated later:						
Before March 10		5	5	0	5.20	5.20
After March 10		16	14	13	3.25	3.71
Mated 2 or more times, not on consecutive days:						
Before March 10		97	64	34	2.69	4.08
After March 10		39	28	28	2.85	3.96
(c) Total—no segregation made						
Mated once		187	135	28	2.56	3.54
Mated two days consecutively		106	93	12	3.58	4.08
Mated 2 days consecutively and remated later		21	19	10	3.71	4.11
Mated 2 or more times, not on consecutive days		136	92	32	2.74	4.04

TABLE 5

FERTILITY AS INFLUENCED BY INTERVALS BETWEEN COPULATIONS. FROM HANSSON (1944)

	Number of copulations and intervals between copulations in days													
	One	Two copulations								Three copulations				
		1	2	3–4	5–6	7–8	9–10	11–12	13–	1	2	3–4	5–6	7–
Number of females	696	99	278	53	35	157	184	111	107	59	339	48	15	42
Kits per female	2.77	3.83	3.73	3.09	2.37	3.46	3.72	4.16	4.04	4.41	4.04	3.91	3.47	4.38
% of sterile females	32.6	9.1	18.0	20.8	37.1	18.4	15.2	14.4	11.2	6.8	9.7	14.6	26.7	14.3
Kits per pregnant female	4.11	4.21	4.54	3.90	3.77	4.24	4.38	4.86	4.56	4.73	4.45	4.59	4.73	5.11

age was 4.75 kits per litter and under the second 5.44. However, under his method of using a vasectomized male to find out whether a female is ready to breed and then mating but once either at the time or after an interval of approximately 7 days litters averaged 5.80. A considerable number of experiments will need to be made before all these observations can be reconciled and the effects of different breeding practices summarized.

Mink may ovulate more than once during the breeding season. It is possible that as many as 20–30 eggs are fertilized. Yet, in many cases, the largest litters in a commercial herd are produced by single matings. As has been discussed under superfetation eggs from any or all of these ovulations may result in kits born. But no such numbers are born. The factors involved here were discussed under the causes of prenatal losses.

EFFECT OF AGE OF FEMALE

Many breeders report that the first litter is small, the next several litters are larger, and those after the fourth year become smaller. Although this is true in some cases, our analysis fails to support this as a general conclusion (fig. 8). Since most of the non-productive females and the females bearing small litters are pelted before their second breeding season, the belief that there is an increase in number of kits per litter is understandable. The elimination of "poor producers" continues through the second and third years. The records of 44 females kept for 2 years under our control show that 21 animals had more kits the second year than they had the first, 19 animals had litters smaller than their first, and 4 animals had the same number of kits both years. These numbers are small but are probably significant. Only 7 females were followed through 3 years. Of these, 4 bore their largest litter during the third year. One animal of this group bore smaller litters each succeeding year, one female had a smaller litter the second year and then bore a litter of the same size the third year, and one bore the same number of kits each year.

In one herd (L) there was a slight but significant tendency for the individual female to raise the same number of young in several seasons (table 6). This was true when using the count of young made after they were old enough to sex as well as when considering only those litters in which the later count agreed with the first, early count. In the latter case, presumably, none of the young had died before the second count, so the count represents fairly accurately the number born. If only the second count is used one is measuring the number living at about 8 weeks after birth.

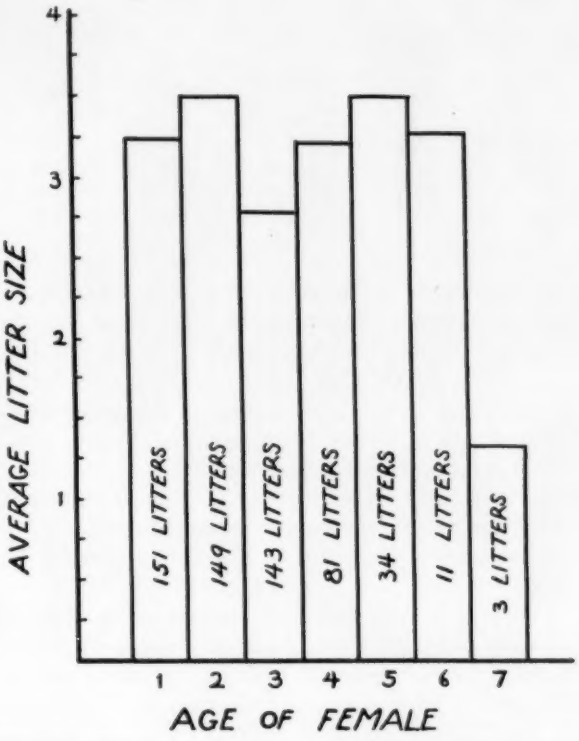


FIG. 8. Relationship of age of female to average litter size.

In the other herd (T) there was no tendency for females to have the same number of young in

TABLE 6

VARIANCE IN LITTER SIZE IN SUCCESSIVE YEARS, USING LATER COUNT OF KITS, I.E. 6–8 WEEKS

		Sum of squares of deviations	Degrees of freedom	Mean square deviation
Ranch L	Within females	331	147	2.25
	Between females	402	95	4.23
Snedecor's F = 1.9		1% point = 1.5		
Ranch T	Within females	750	285	2.63
	Between females	599	217	2.76
Snedecor's F = 1.05		5% point = 1.2		

These results are confirmed by the correlation between: Kits whelped by yearlings × mean number of kits whelped by same females in subsequent years:

78 L females + .37 ± .10 (S.E.)
184 T females + .08 ± .07 (S.E.)

TABLE 7

	Kits per litter	Non-pregnancies (%)	Kits per female
Adult ♂ × adult ♀	4.54	19.4	3.68
Adult ♂ × kit ♀	3.82	19.7	3.07
Kit ♂ × adult ♀	4.29	27.3	3.12
Kit ♂ × kit ♀	4.24	28.2	2.97

several litters. The reason for this difference is not apparent. Management, measured by the average number of kits per litter raised, was better on the ranch where no correlation was found. Poorer management, resulting in a large number of kits dying before being counted, might mask the tendency toward bearing litters of the same size in several seasons. Yet, on the basis of kits per litter raised, the poorer managed herd showed this tendency while the better managed herd did not.

To add to the difficulty, and possibly demonstrating that the two herds are not comparable because of management, genetic, or other factors of which we are not aware, the two herds differed in another fundamental respect. Females kept 2 or more years bore more kits per litter in their second year than in their first on one ranch (T) but not on the other (L).

Hansson ('47) shows that there is an increase in the size of litter born the second year and a steady drop thereafter (p. 117).

ROLE OF THE MALE IN SIZE OF LITTER

In one herd (L) previously referred to, individual females showed a tendency toward constant litter size, but there was no such tendency on the part of the males. This is the only herd from which sufficient data are available to determine this point.

Fewer kits are produced per mated female when females are mated to yearling kit or "yearling" males than when mated to older males (table 7). The slight difference in the size of litters produced by kit and adult males is not significant. Considerable difference in total production is due not to smaller litters but to the higher percentage of non-pregnancies when kit males used.

VARIATION IN FERTILITY

Fertility of whole herds varies from year to year. Also, in some years reproduction is better than in others not only on individual ranches but on ranches all over the country. For instance, kit production during the breeding season of 1946 was low all over North America. The cause or causes of these fluctuations in fertility are unknown for many ranches have not changed management practices nor breeding stocks for some years, yet they, too, experience considerable variation in results. Many explanations ranging from the poor qualities of food supplies available to deterioration of reproductive capacity through inbreeding, have been advanced for the lower fertility experienced in "low" years. Thus far not enough is known of the cause or causes of these wide-spread fluctuations to justify any conclusions.

The assumption that in mink the tendency to bear large litters may be inherited is not supported by statistical analysis. Only comparatively recently has much attention been paid to the selection of breeding animals from large litters.

SEX RATIO

The ratio of males to females at approximately 8 weeks of age is 104 to 100. In one case, involving 76 litters, the females outnumbered the males. Here the ratio dropped to 90 to 100. The previous year the ratio in the same herd was reversed, being 107 to 100. The figure 104 to 100 was derived from records of several herds over a period of years, involving approximately 8,000 animals. Apelgren ('41) calculated the sex ratio on the basis of litter size. He found that litters of single kits average 55.8 per cent males while in large litters the percentage of males drops to 47. With proper caution Apelgren states that his figures only indicate that the mortality during gestation is higher for males in larger litters. This difference in the variation of the sex ratio with litter size does not explain differences in sex ratio in the herd referred to above, for there was little difference in litter size between the 2 years in which the ratio was 90 to 100 and 107 to 100.

The greatest deviation from these figures was reported by Noyes ('41). He injected a preparation of pregnant mare serum (Gonadin) before exposing the females to the males, and again after breeding. The 10 females so treated bore 55 kits of which only 5 were males. This recalls the report of Andreoni ('39, quoted from *Biological Abstracts*) where the administration of 200 m.u. of folliculin per day before estrus increased the proportion of females subsequently produced in rabbits.

SUMMARY

The mink on fur farms were derived comparatively recently from the subspecies of wild mink that range across northern North America. While there is some difference in the onset of estrum between subspecies, these differences are no greater than differences between animals kept in different latitudes, i.e., New York and Sweden.

More than 400 mink were maintained in the laboratory and several experiments were conducted on a large scale at the U. S. Fur Animal Experiment Station. Much material was secured from fur farmers. Some wild caught animals were available, and the records of thousands of animals were used in analyzing length of gestation, relation of size of litter to date of mating, effect of age of female on litter size, and the role of the male in litter size.

The mink has a restricted breeding season each spring. Ovulation and spermatogenesis occur between February and May. Females isolated from all other mink do not develop ovarian follicles as large as those found in the ovaries of females that are kept in single cages where they are aware of the presence of other females or males. Ovulation is not spontaneous but follows copulation or a similar stimulus by approximately 48 hours. Ovulation by psychic stimulation is easier to induce in mink than in ferrets. Females may or may not breed again following ovulation.

Pregnancy lasts 40 to 75 days with a mean length of 51 days. The length of gestation varies significantly with the date of insemination, the longer periods being associated with early ovulation. The length of gestation equals 59–31 days minus 0.44 × mating date. Variation in the length of pregnancy is associated with delayed implantation, for the copulation-ovulation-fertilization sequence is constant as is the implantation-parturition sequence. Implantation can be hastened, up to a certain point, and pregnancy shortened by lengthening the day artificially. Implantation-parturition lasts 30 ± 1 days.

Blastocysts remain in the anterior portion of the uterus during the resting stage. The inner cell mass contains 110–164 cells and is, therefore, larger than that of the badger, about the same as in the weasel but smaller than that of the marten or fisher.

The size of litters appears to be dependent on chance or skillful management to a greater extent than in other mammals, although larger litters result from matings that take place in the middle of the breeding season. Not only do smaller litters result from early or late breeding, but also many females so mated fail to ovulate or to become pregnant. In matings in which ovulation takes place but the animals do not become pregnant pseudo-pregnancy usually follows and lasts as long as pregnancy.

Following her first ovulation of the season the female may breed and ovulate one or more times. While the litter usually contains more kits from the last breeding, kits from each of these ovulations may be born or all the kits may be from any one or two of the matings.

The anatomy of the reproductive tract of both the male and female is described and some aspects of behavior are discussed.

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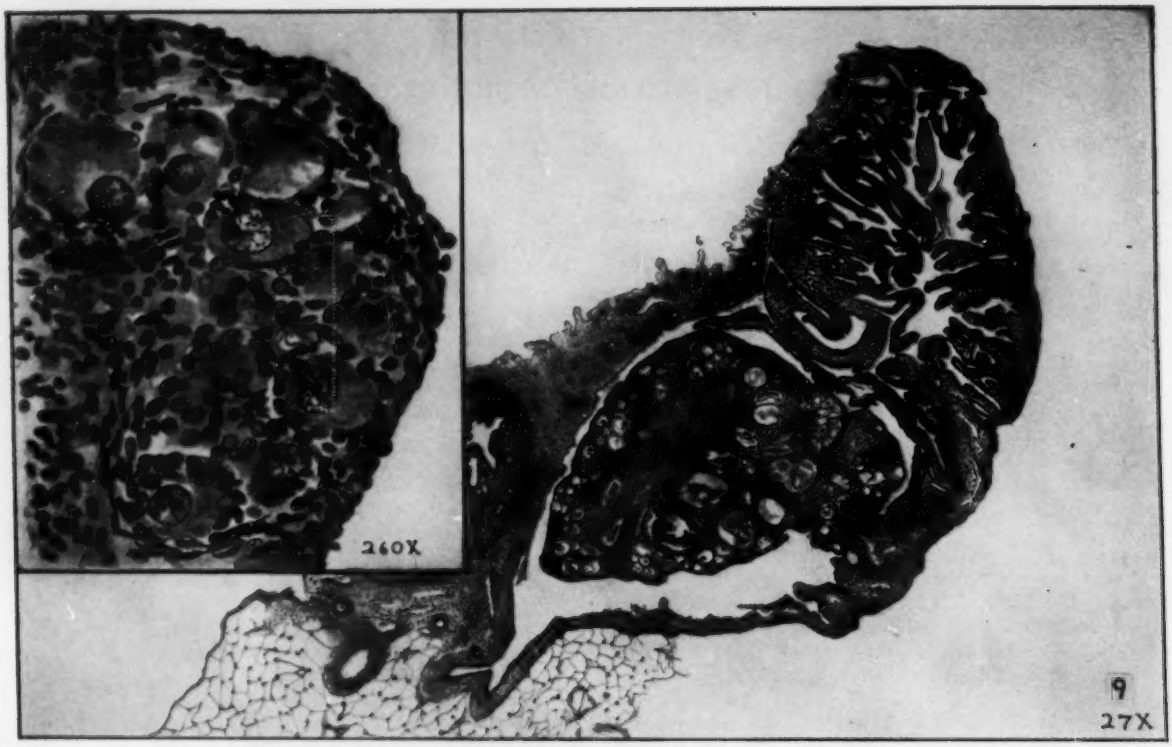
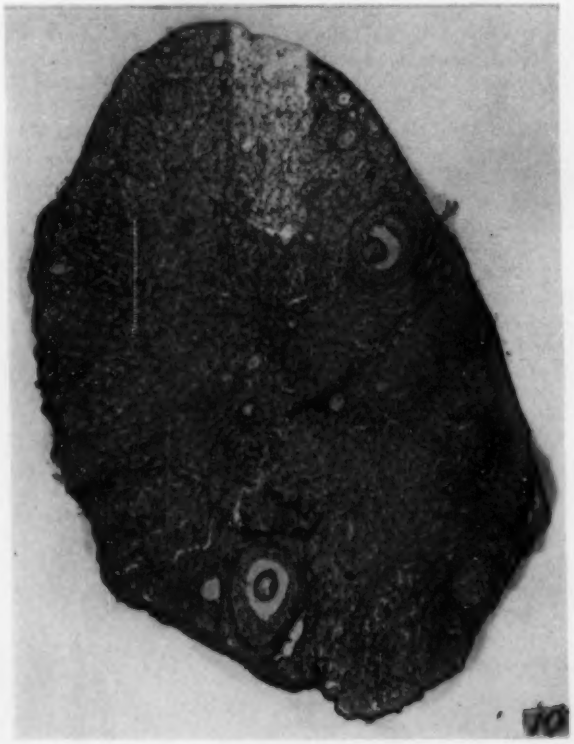
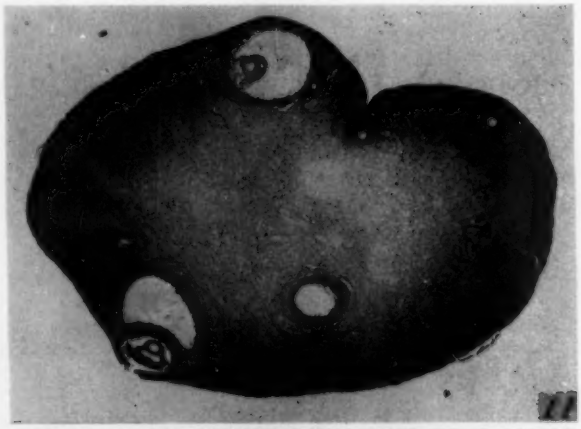


FIG. 9. Section through ovary, capsule and oviduct of mink kit approximately 5 months old. Detail of ovarian "nests" from near hilus. Note fimbriae and location of ovary.





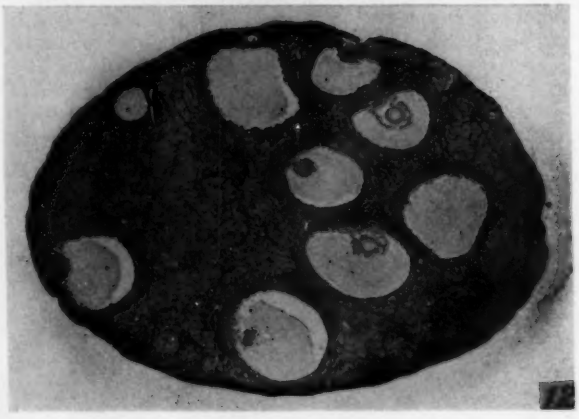


FIG. 10. Section of anestrous ovary. About 22×
FIG. 11. Ovary of isolated animal. Two full pre-inseminal and 2 atretic follicles.
FIG. 12. Follicles of full pre-inseminal growth. Female not isolated. 11×
(Figs. 9–68 were made at magnifications given but in reproduction were reduced somewhat.)

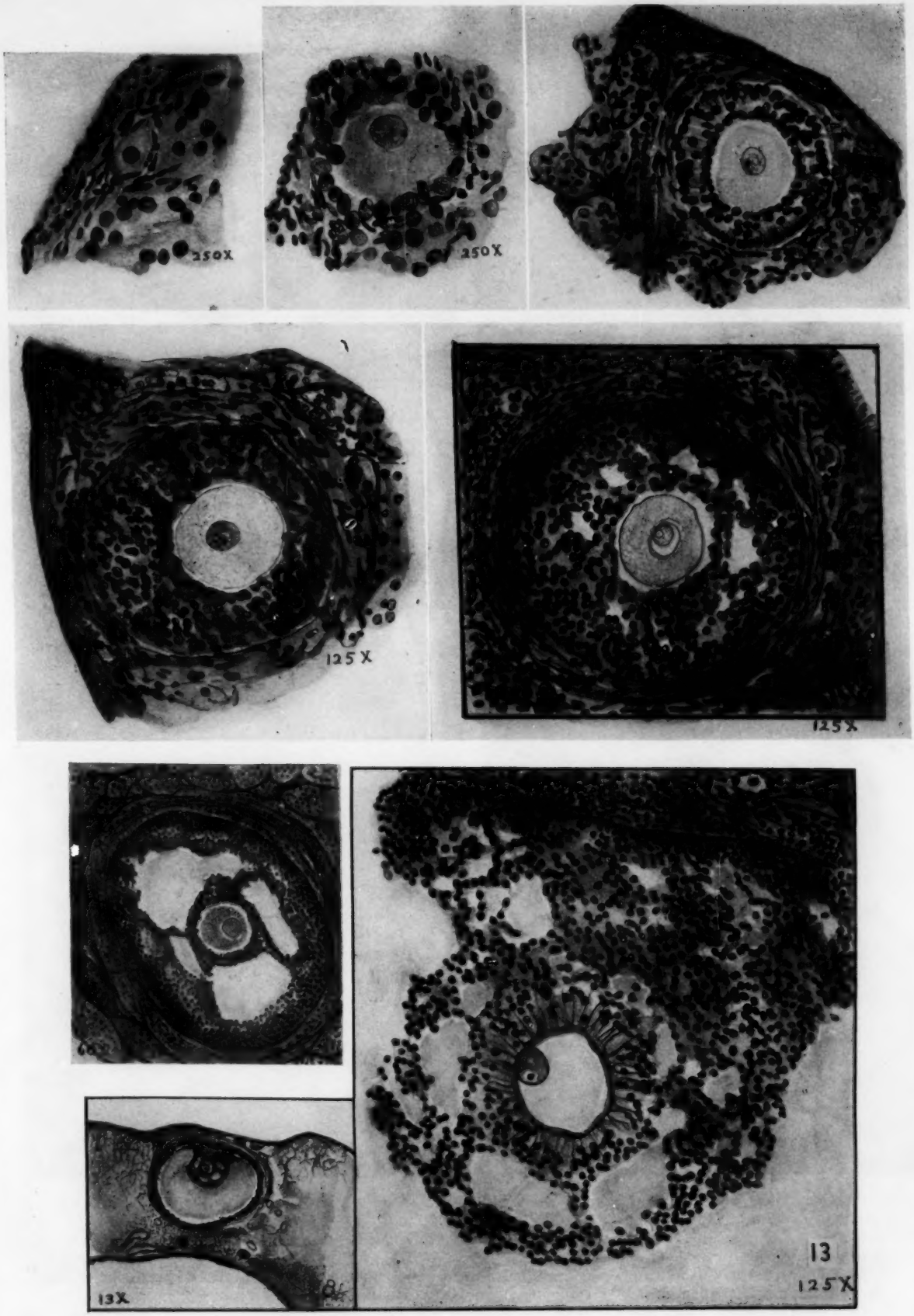
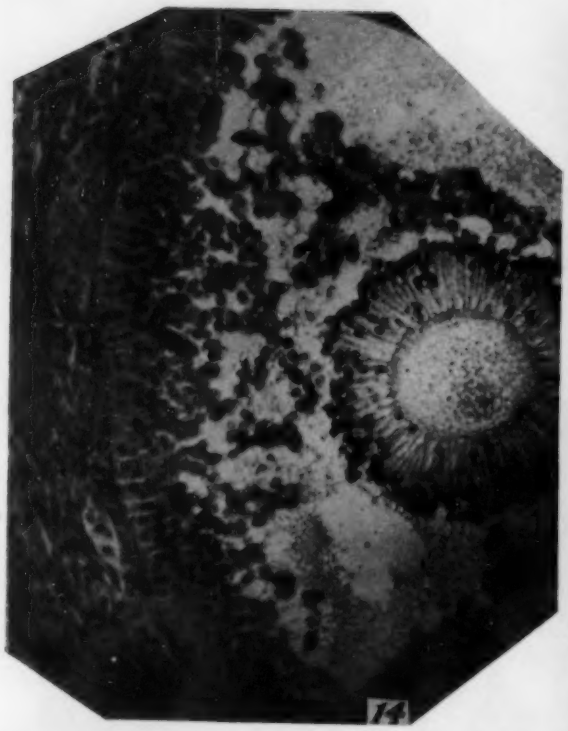
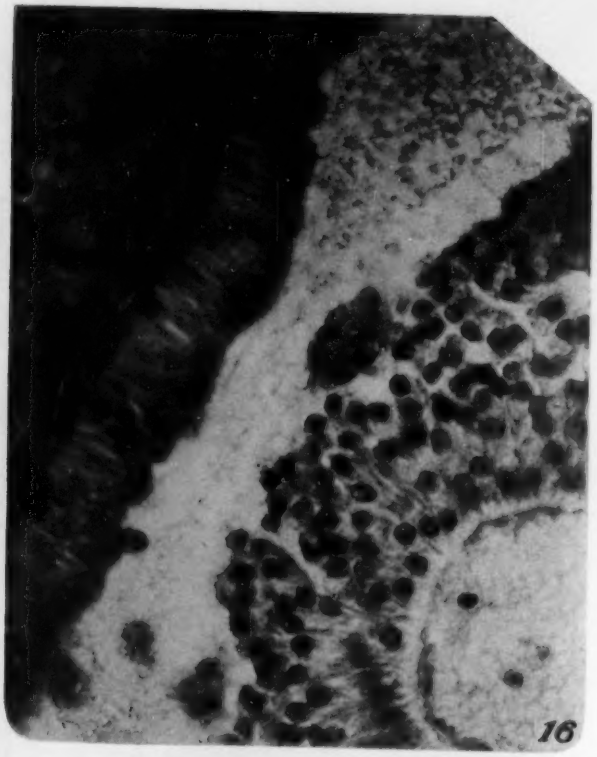
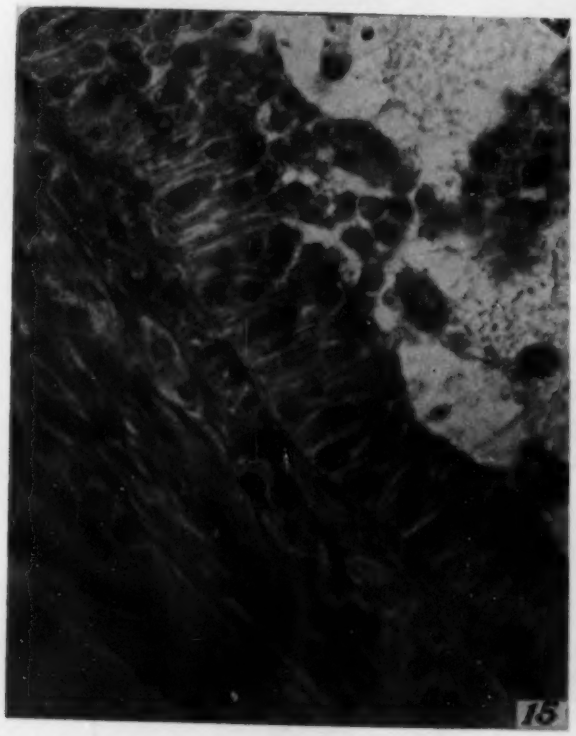


FIG. 13. Development of the follicle.







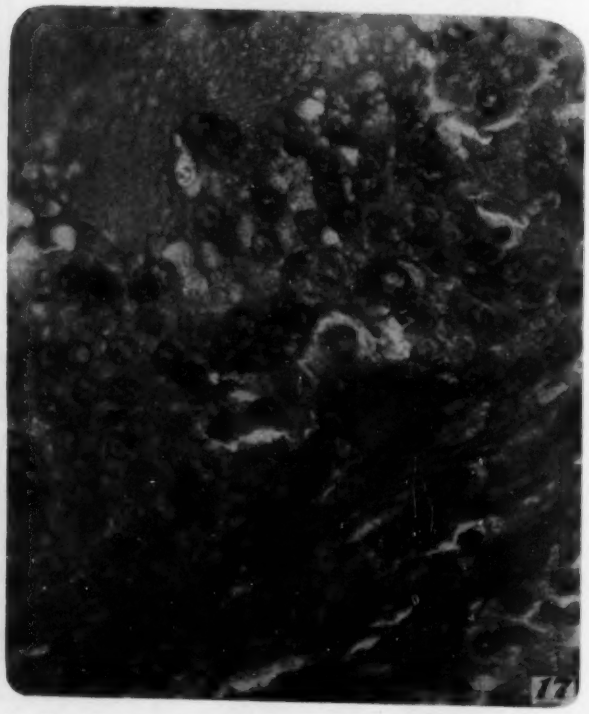


FIG. 14. Ovum and portion of follicle of full pre-inseminal growth. Note spectacular corona and method of detachment of ovum from cumulus. 160×

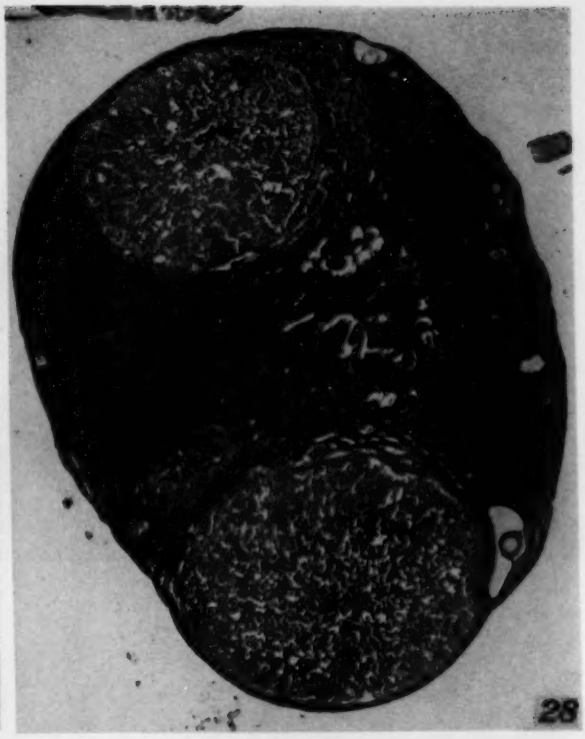
FIG. 15. Detail of follicular wall of same follicle. Basal layer of granulosa cells is somewhat columnar and nuclei have migrated away from basement membrane. 380×

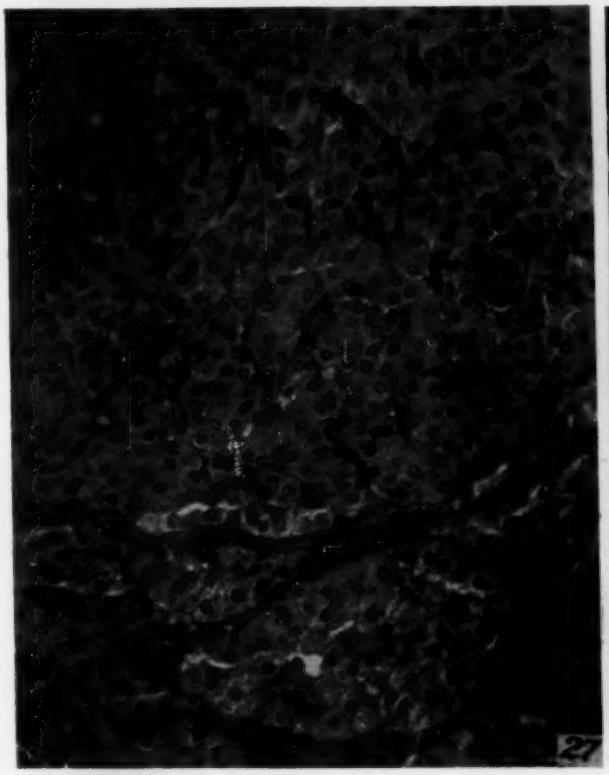
FIG. 16. Corona and granulosa 2 hours post-coitum. Basement membrane is beginning to disappear, nuclei of corona cells no longer apical, chromatin of ovum condensed, nuclear membrane gone. 380×

FIG. 17. Granulosa of follicle which has just ovulated, 50 hours post-coitum. Extensive invasion of blood vessels with escape of blood into follicle. 380×

FIG. 18. Detail of follicle of full pre-inseminal growth. Isolated.
FIG. 19. 43 hours post-coitum. Detail of rupturing follicle.
FIG. 20. 43 hours post-coitum showing rupturing follicle, ruptured follicle, and atretic follicles. 15×
FIG. 21. Rupturing follicle 46 hours post-coitum. 200×

FIG. 22. Follicles rupturing 46 hours post-coitum.
FIG. 23. Corpora lutea 18 days post-coitum. 15×
FIG. 24. 90 hours post-coitum. Two atretic follicles did not rupture; young corpora lutea at top and bottom. 15×
FIG. 25. Corpora lutea; late pregnancy. 13×





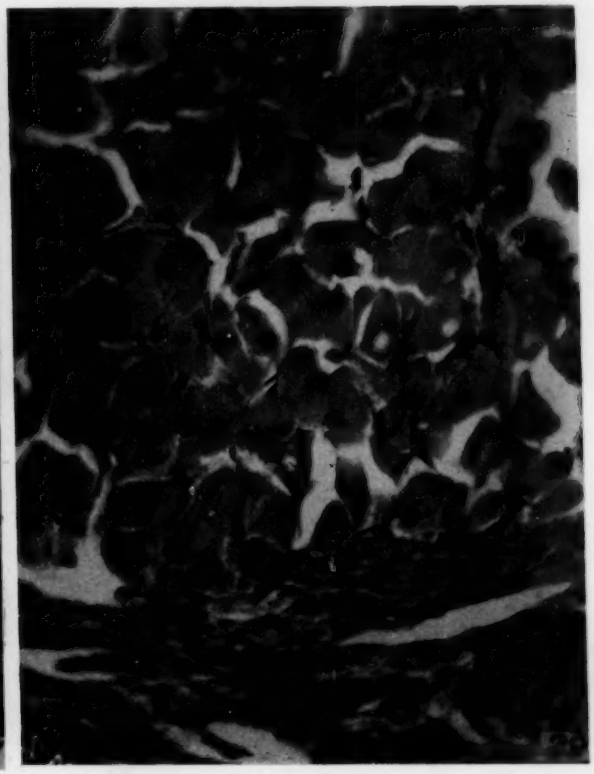
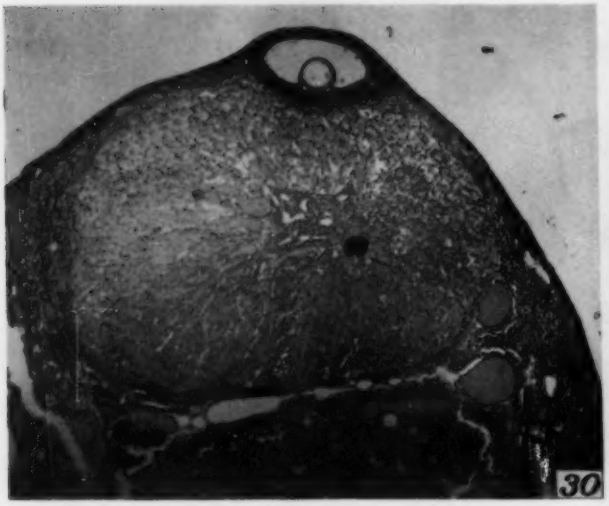


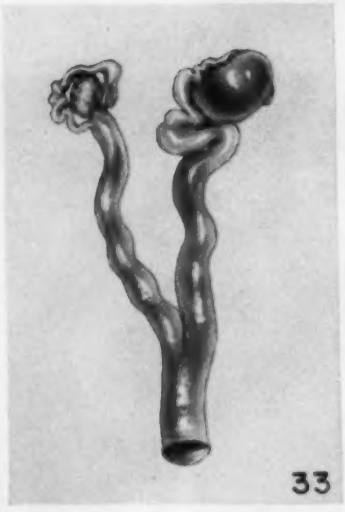
FIG. 26. Ovary 14 days after mating. One of the unimplanted blastocysts from the uterus of this animal is shown in figure 67, and the uterus in figure 61. Note the small size of the corpus luteum, which is sectioned through its maximum diameter, and the large follicles. 21×

FIG. 27. Detail of the corpus luteum shown in figure 26. 230×

FIG. 28. Ovary 20 days after mating. A large blastocyst preparing to implant in this animal is shown in figure 68. Note the large size of the corpora lutea. 21×

FIG. 29. Detail of the corpus luteum shown in figure 28. 230×





FIGS. 30 and 31. Follicle between corpus luteum and periphery of ovary. 16 days after mating. Whelped May 4. 50× and 250×

FIG. 32. Uterus, oviducts, and ovaries in proestrus mink.

FIG. 33. Uterus and adnexa. Capsule on left removed to show relation of fimbriae and oviduct to ovary and uterus. Capsule on right distended. Two hours post-coitum.

FIG. 34. Uterus, oviducts, and ovaries in early pregnancy.

FIG. 35. Fragment of pregnant uterus. Note small diameter of uterus away from placental site.

FIG. 36. Reconstruction, longitudinal section, through cervix and vagina.

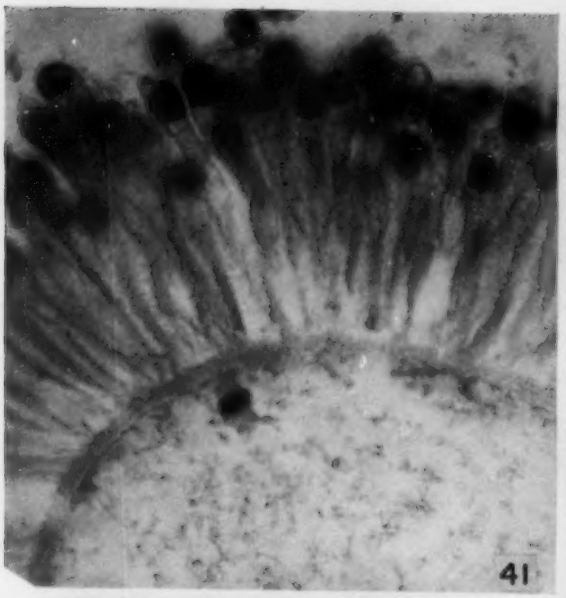
Section through vagina during anestrum (December)

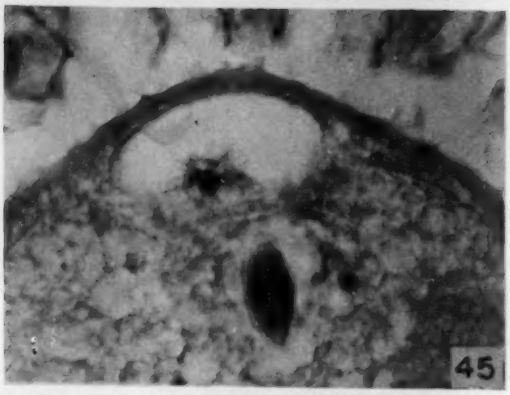
FIG. 37. Longitudinal section. 38×

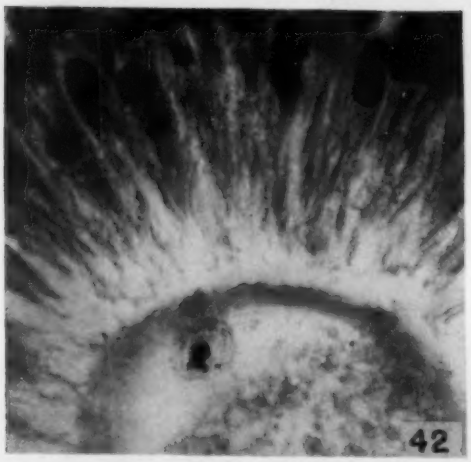
FIG. 38. Detail of portion of vagina to left. 160×

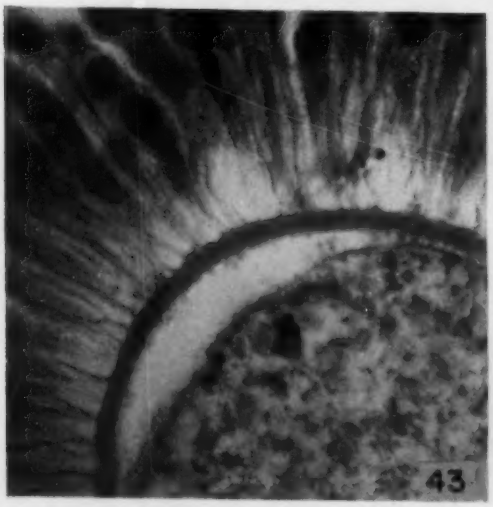
FIG. 39. Detail of part of above. Luminal surface is intact, cells cuboidal to columnar. 370×

FIG. 40. Section of vagina in early estrum. 26× and 115×









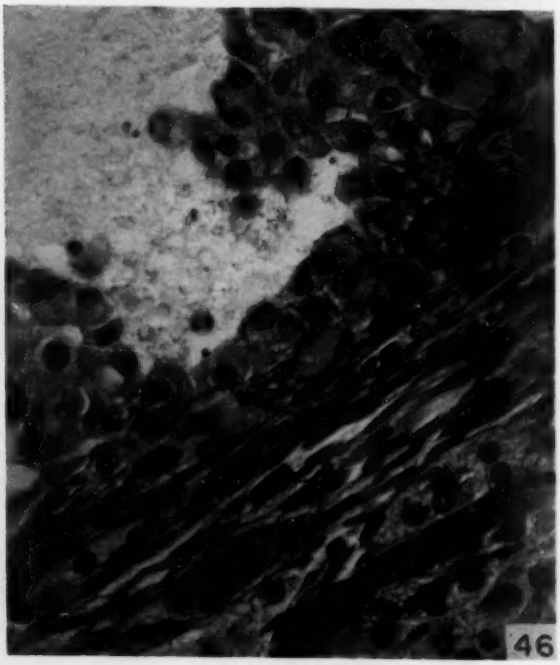
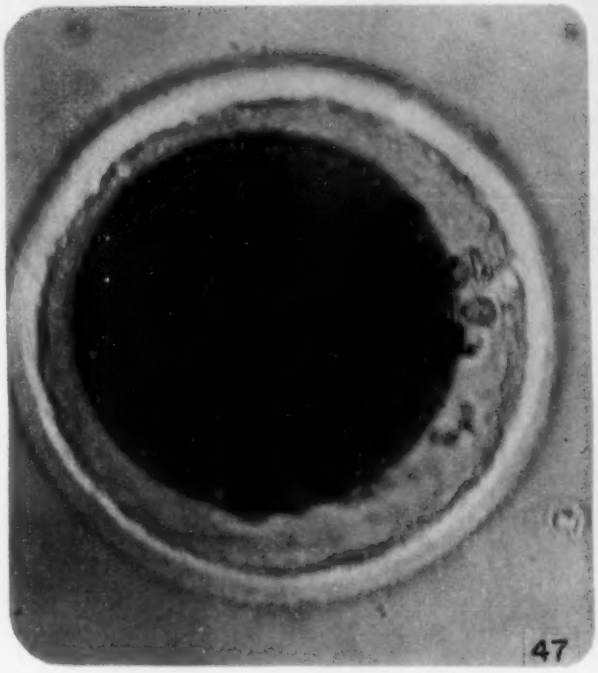


FIG. 41. 38 hours post-coitum, first spindle stage. Corona cells slightly club-shaped. 710×
FIG. 42. Ovum 38 hours post-coitum. First polar body (telephase of first division). 710×
FIG. 43. Ovum 38 hours post-coitum, chromosomes of ovum after first maturation division. 710×
FIG. 44. Ovum 50 hours post-coitum. Seven follicles had ruptured, four had not. Second maturation in metaphase. 93×
FIG. 45. Same as figure 44. 710×
FIG. 46. Detail of wall of follicle about to ovulate. 50 hours post-coitum. Granulosa cells luteinizing and forming tufts. Blood vessels invading follicle. 380×



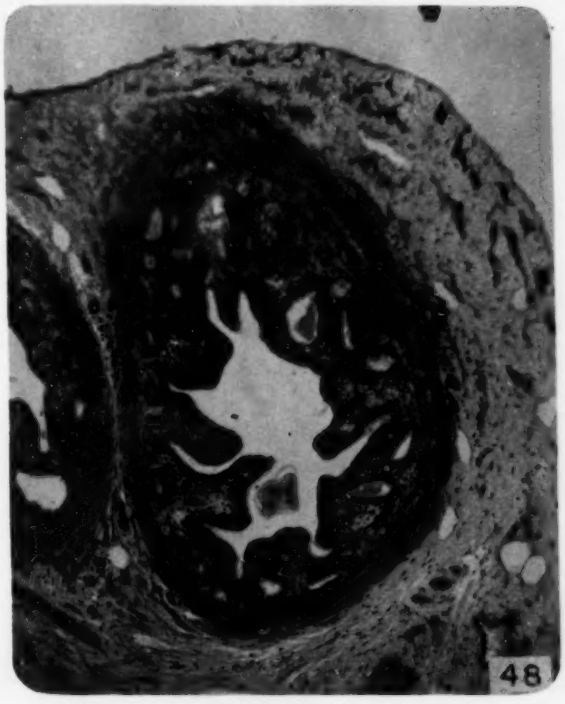


FIG. 47. Living ovum approximately 53 hours post-coitum. Note what appear to be polar bodies at right side of vitellus. 400×

FIG. 48. Section through oviduct showing 8-celled ovum. 260×

FIG. 49. Detail of ovum and epithelium of oviduct. 65×

FIG. 50. Cross-section through ovary, bursa, and oviduct 77 hours post-coitum showing two early corpora lutea. Note 8-celled ovum in upper right hand portion of the bottom section of the oviduct. 10×

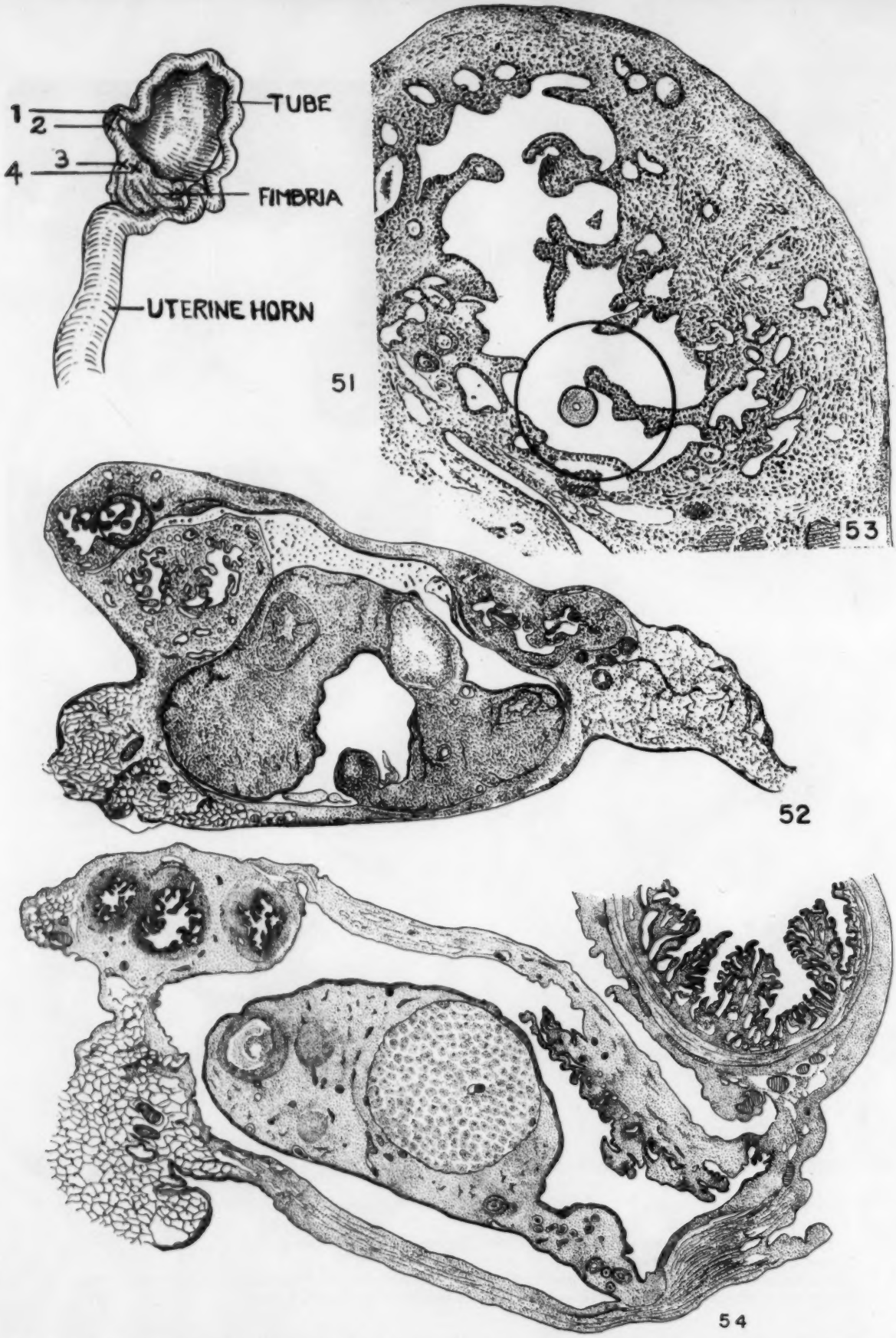
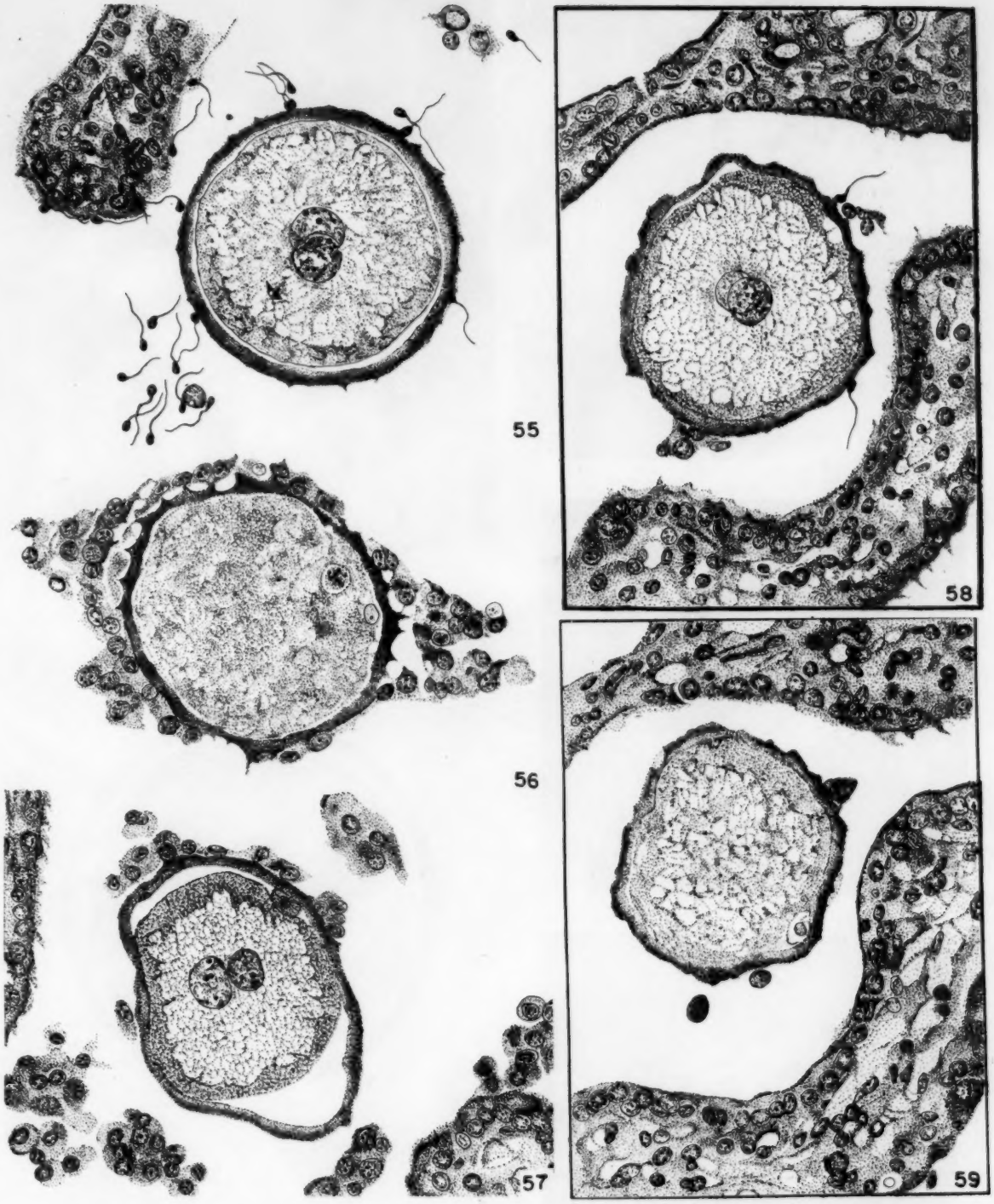
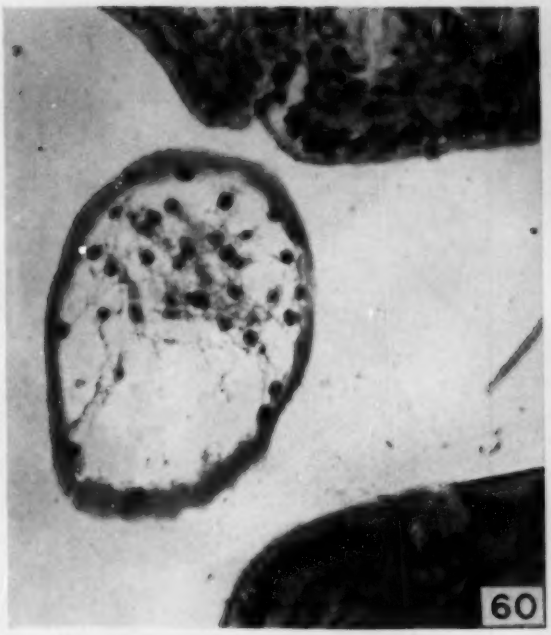


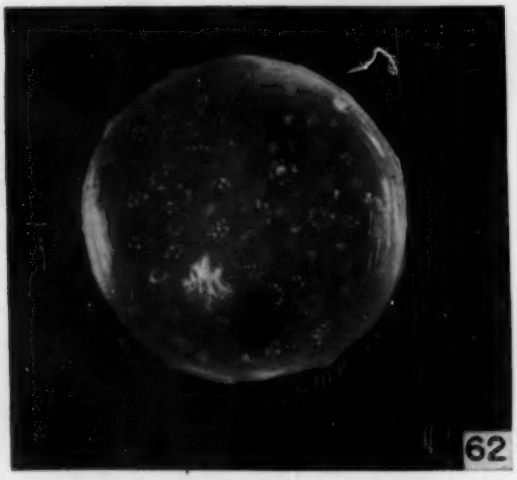
FIG. 51. A reconstruction of oviduct and uterus with locations of ova marked and numbered. 53 hours after copulation.
FIG. 52. Cross-section through ovary, capsule, and oviduct showing location of ovum no. 1. FIG. 53. Detail of oviduct.
FIG. 54. Drawing of cross-section through ovary, bursa, oviduct and uterus of pregnant mink. Section passes through posterior portion of ovary.



Details of ova 53 hours post-coitum, all 260×. The location of these ova in the oviduct is shown in figures 51–53.

FIG. 55. Ovum 1. The spermatozoa are illustrated more clearly than they appear on the slides.
FIG. 56. Ovum 2. Polar body formed.
FIG. 57. Ovum 3. Showing male and female pronuclei; polar body next to colemma.
FIG. 58. Ovum 4. Showing male and female pronuclei.
FIG. 59. Ovum 4. Showing polar body.





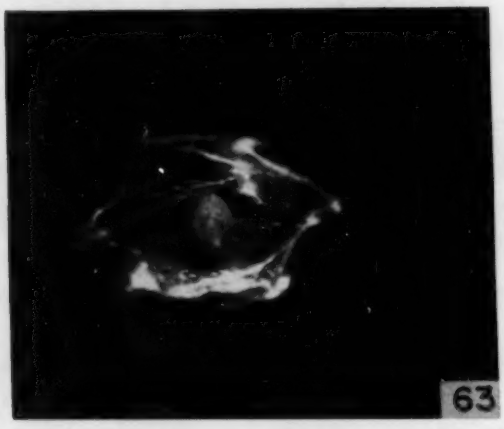
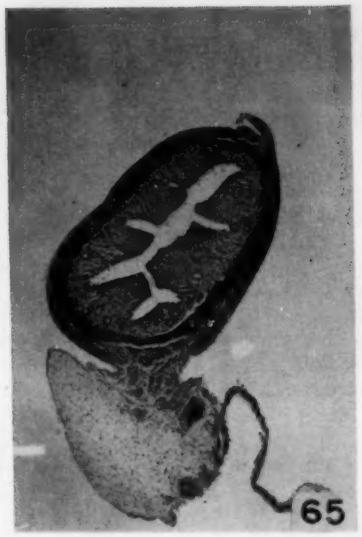
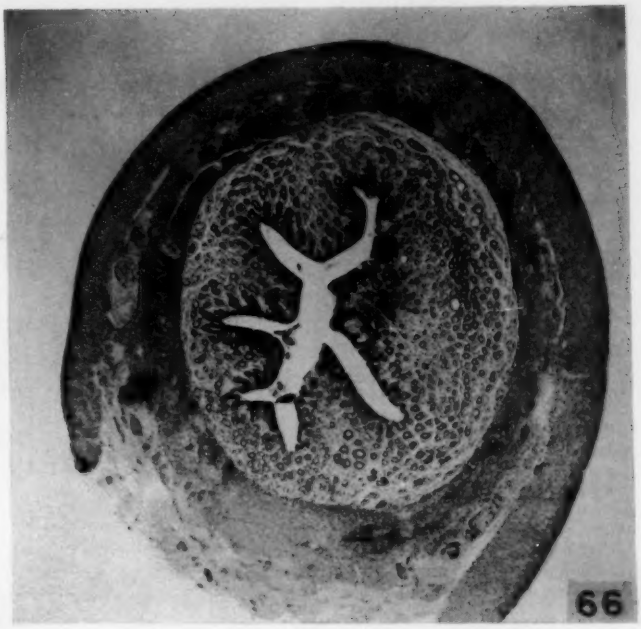
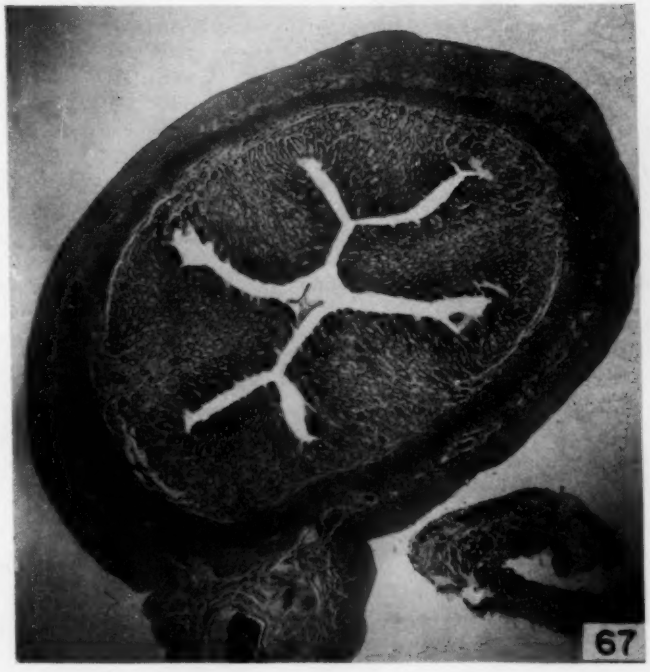


FIG. 60. Blastocyst in uterus, 10 days after mating. 240×
FIG. 61. Blastocyst in uterus, 14 days after mating. 120×
FIG. 62. Drawing of blastocyst 17 days after mating. 51×
FIG. 63. Blastocyst dissected out from uterine bump after fixation in formalin 9×
FIG. 64. Reconstruction of inside of blastocyst, inner cell mass at lower left. As in above the spots of light appear to be oriented about the cell nucleus.







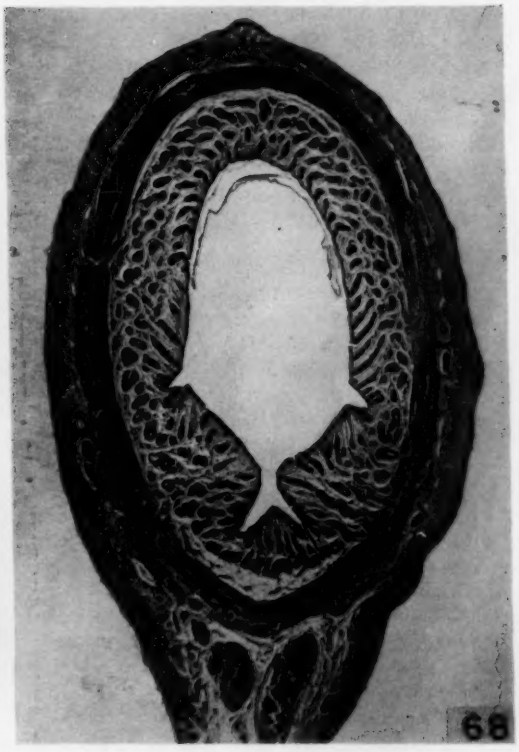


FIG. 65. Anestrous uterus. 20×
FIG. 66. Estrous uterus 43 hours after mating; ovulated. 20×
FIG. 67. Uterus with blastocyst 14 days after mating. 20×
FIG. 68. Uterus with embryo 20 days after mating. No swelling was visible in uterus, but a pale sphere was seen with dissecting scope. Blastocysts were washed out of the other horn at 16 days. 20×

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